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Twin Cupolas Melt Wheel Iron

Improved Product and Economy of Operation Are Among the Claims Advanced in Favor of a Pair of Cupolas Connected by a Common Chamber Below the Tuyeres

BY PAT DWYER

RAILROAD carriers in the United States operate 150,000 miles of track and move freight in 3,125,000 cars, a sufficient number if placed end to end to form an almost complete chain around the world. With each link of the chain represented by a freight car supported on 8 wheels it readily is apparent that at least 25,000,000 wheels are in active service. The present capacity of car wheel foundries in the United States and Canada is given as 20,000 per day; but owing to the greatly increased carrying capacity of freight cars in recent years, this number represents a much greater foundry melting tonnage than it did 20, 10 or even 5 years ago, when wheels were lighter and smaller.

A typical instance of this trend toward heavier car loading is shown in the report of one division of the New York Central railroad for the month of July, 1923, when a new record was established in handling iron ore at the port of Ashtabula, O. Ore to the extent of 83,086 tons was unloaded in one day from ten lake carriers and loaded in 1386 cars for direct shipment to blast furnace plants in the Youngstown and Pittsburgh districts. The significance of this report is apparent when

FIG. 1—METAL FROM TWO CUPOLAS COLLECTS IN A RECEIVER FROM WHICH IT IS TAPPED INTO A 5-TON LADLE—THE TILTING GEAR ON THE LADLE IS ELECTRICALLY CONTROLLED FROM A PULPIT (NOT SHOWN) SITUATED AT A POINT MIDWAY BETWEEN BOTH PAIRS OF CUPOLAS AND ABOUT 30 FEET AWAY WHERE THE OPERATOR HAS A CLEAR VIEW

a comparison is made with a record set 7 years previously, in July 1916. On one day in that month, 80,179 tons of iron ore were loaded into 1608 cars. The new record shows an increase of 2907 tons handled in a given time and a decrease of 222 in the number of cars employed. The average car load in 1916 was 50 tons. In 1923 it was 60 tons, an increase of approximately 20 per cent.

According to the latest available statistics, some 5000 foundries in the United States and Canada are engaged in the production of gray iron castings. Out of this number only 49 specialize in the manufacture of cast iron chilled car wheels, and yet these 49 account for one-seventh of all the pig iron melted in the foundry industry. Placed on a percentage basis it is even more apparent that each foundry handles a large tonnage of castings daily and that the combined foundries represent the largest single unit in the foundry field. They constitute 1 per cent of the total number of foundries and absorb 14 per cent of the pig iron diverted to foundry use.

Built for Heavy Service

The standard, chilled-iron, car wheel may be manufactured more cheaply than any other form of wheel that has been tried. This statement is not to be construed as meaning that the wheel is of an inferior quality nor that it is not satisfactory for the purpose for which it is used. With the possible exception of chilled rolls, no iron castings are made that have to meet such severe and rigid specifications, physical and chemical, as cast iron car wheels.

The high standard of excellence attained is reflected in the product. Each wheel is guaranteed for from 4 to 6 years according to the capacity of the car, during which time it is anticipated that it will travel at least 50,000 miles. It does not seem possible that any material could carry a heavy load and stand such a severe test. Taking the weight of the average loaded freight car at 150,000 pounds it is apparent that each of the 8 wheels is obliged to support a load of 18,750 pounds. Not only support it but revolve freely under it, endure a hammer knock at each rail joint and suffer strains and friction heating at frequent periodic intervals from the application of powerful brakes. Only on rare occasions do wheels fail before the expiration of the guarantee period. Usually they exceed it by a comfortable margin.

The chilled, cast-iron car wheel primarily is an American product. The standard wheel has a 33-inch diameter tread irrespective of the weight which includes four classes. These are 650-pound wheels for 60,000 pound capacity cars, 700 pound wheels for 80,000-pound capacity cars, 750-pound wheels for 100,000-pound capacity cars and 850-pound wheels for 140,000-pound capacity cars. The gross weight of each type of car cited is much greater. For example the gross weight of the fourth type car is 210,000 pounds.

First introduced about 1835 chilled-iron, car wheels came into general use on American railroads about 1850, after Asa Whitney had discovered and demonstrated the advantages accruing from annealing or *pitting* the wheels. The process was patented by the inventor in 1847. At about the same period a number of other patents were taken out by various men covering certain features in the design of the wheel and methods for chilling the tread.

The growth of the chilled, car-wheel industry has kept pace with the railroad expansion. The wheels still are made on the broad general principles laid down by Asa Whitney, but many modifications in melting and molding practice have been adopted from time to time based on personal experience of prominent men in the industry. The Albany Car Wheel Co., Albany, N. Y., furnishes an interesting case in point.

Operates Several Foundries

J. A. Kilpatrick, president of the Albany Car Wheel Co., had an extended experience as general manager of the Canada Iron Corp., and other companies in the manufacture of car wheels before taking over and rejuvenating the car wheel branch of the old Thacher foundry in Albany, N. Y., in

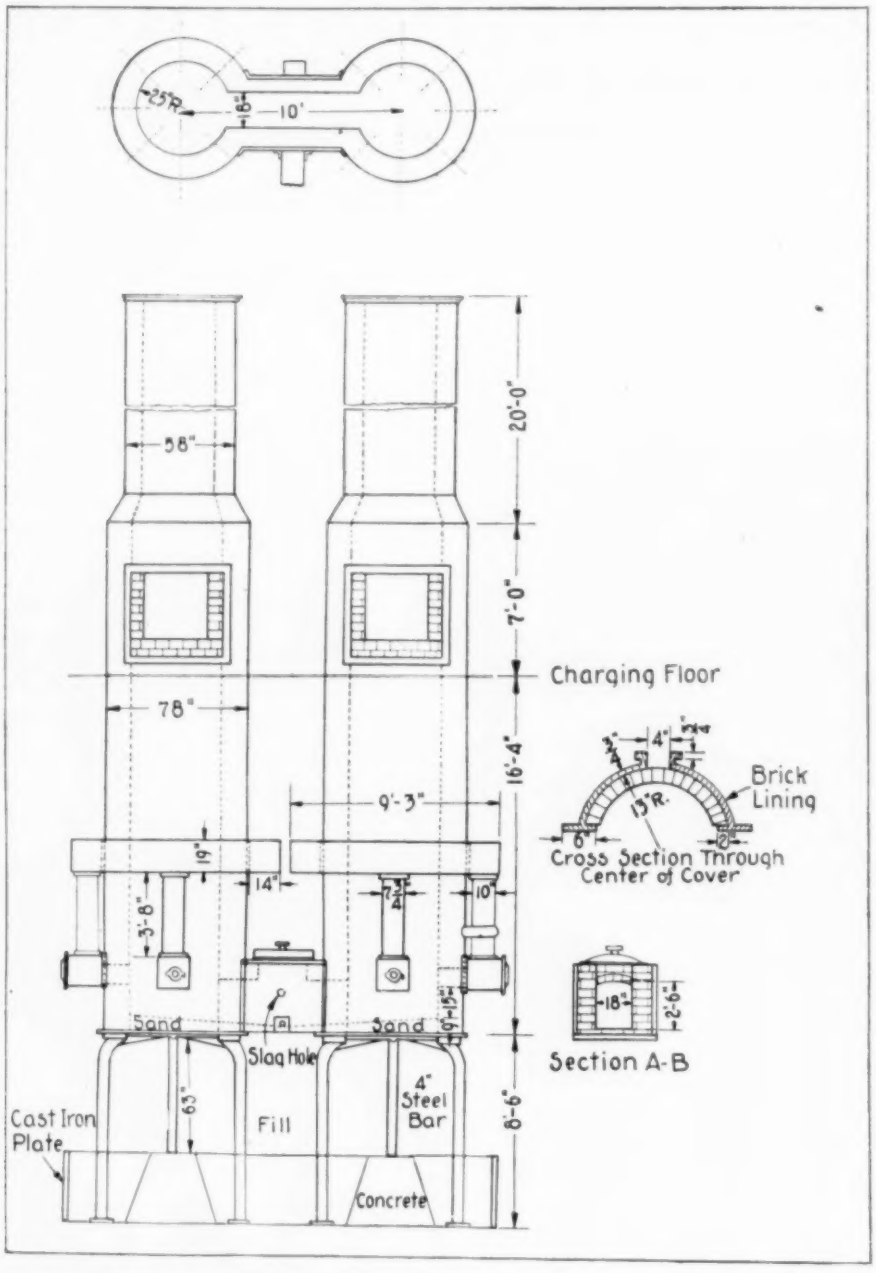

FIG. 2—GENERAL VIEW OF TWIN CUPOLAS WITH SECTIONAL DETAIL OF CONNECTING CHAMBER AND COVER—ABOVE—CENTER LINE OF TUYERES AS THEY APPEAR ON THE PLAN BELOW THE WINDBOX

1911. This plant soon proved inadequate and the company began to cast around for a more suitable site. Negotiations were hurried to a considerable extent by the fact that the old foundry burned down before the change was made. Abandoned buildings on property belonging to the Delaware & Hudson railroad, a short distance beyond the corporate limits of the city of Albany on the north were adapted for use as a wheel foundry.

The property consists of 15 acres and in addition to the Delaware & Hudson railroad, the plant also is served by a spur from the New York Central railroad. Since the Albany Car Wheel Co., acquired control of the property in 1913 the plant has been greatly enlarged and extended from time to time. At present it has a daily capacity of 350 wheels which involves melting approximately 175 tons of iron. In addition to the Albany plant, the company also owns and operates car wheel foundries in Reading, Pa., Winnipeg, Man., Toronto, Ont., and New Glasgow, Nova Scotia. With the exception of some minor points of difference, due principally to local conditions, molding, melting, cleaning and annealing practice is uniform in these various foundries. However, some time ago Mr. Kilpatrick introduced some innovations in the melting practice as exemplified at the Albany plant and anticipates installing the same practice in the other foundries of the company in the near future. It is claimed that the new method produces clean, hot, uniform quality metal and at a low cost.

FIG. 4—THE IRON CHARGE IS DUMPED THROUGH THE DOOR ON ONE SIDE WHILE THE COKE IS INTRODUCED THROUGH AN OPENING ON THE OPPOSITE SIDE OF THE CUPOLA

Briefly the process on which a claim for a patent has been filed, consists in melting iron in twin cupolas, allowing it to collect in a central chamber and tapping it therefrom into a mixing ladle. A view of the mixing ladle is shown in Fig. 1, the back of one pair of cupolas is shown in Fig. 3 and a reproduction of a drawing showing the general arrangement of the cupolas together with detail of the central chamber is shown in Fig. 2.

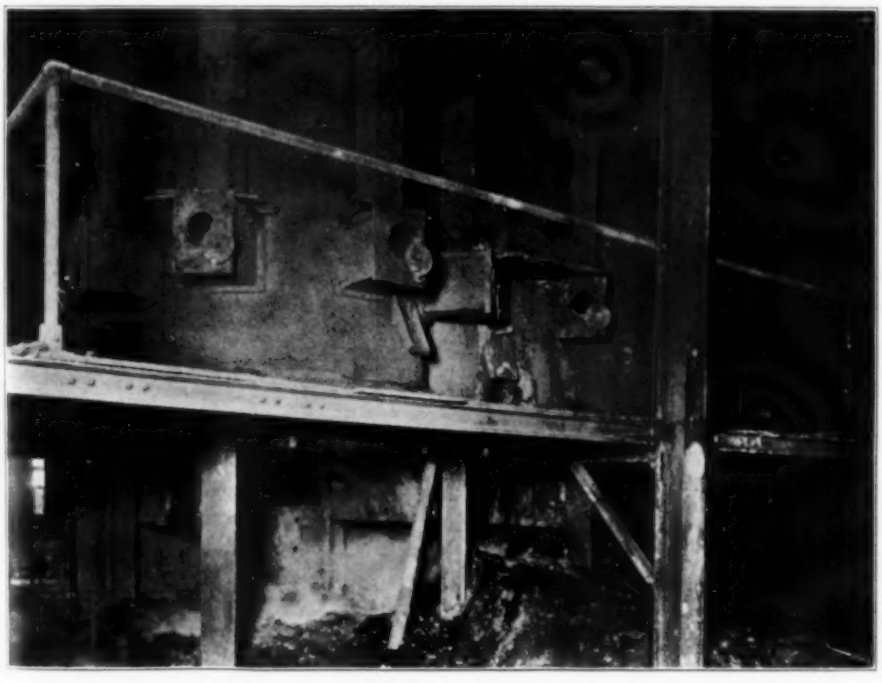

FIG. 3—THE TWO PAIRS OF CUPOLAS ARE PLACED IN BLAST ON ALTERNATE DAYS—THE PAIR SHOWN IN THE ILLUSTRATION WERE IDLE ON THE DAY THE PICTURE WAS TAKEN—THE OUTSIDE OF THE CHAMBER WITH THE COVER REMOVED MAY BE NOTED BETWEEN THE TWO CUPOLAS

To insure continuous operation, two pairs of cupolas have been installed at the Albany foundry. Each pair is utilized to melt iron on alternate days. On intervening days they are chipped, repaired and made ready for the following day. In that manner all the work is under the direct supervision of the superintendent and there is little danger of any error creeping in either in the manner in which the cupolas are prepared or charged. Iron for car wheels must be absolutely uniform and for that reason it is essential that all the factors involved in the operation of the cupola should be kept under close and intelligent supervision.

A close inspection of Fig. 2 will disclose many interesting features. Commencing at the bottom and gradually working upward, the first feature to attract attention is the height of the bottom plate above the floor level. The necessity for this high bottom, 8 feet 6 inches, is explained by the relative positions of the mixing ladle and buggy

ladle shown in Fig. 1. A tapered concrete pillar 3 feet high, 2 feet square at the top is provided in the center of the space between the four legs of each cupola to support the 4-inch steel bar that serves as a prop for the two half bottom doors.

Pendant Tuyeres

The drop from the cupolas has been allowed to accumlate until the floor between and around the legs of the cupolas has been built up to the level of the top of the concrete piers. A vertical iron plate in front and one at each end maintains the floor at a constant height. At the back it slants down gradually toward the wall of the building. This declivity is taken advantage of by the construction of a channel which conveys the liquid slag away from the cupola toward the door where it solidifies and easily is broken up and removed.

In this connection it is interesting to note that the foundry occupies a position parallel and in close proximity to the old abandoned state canal. The bed of the canal now forms a convenient dumping ground for all the refuse from the foundry. It has been utilized for this purpose ever since the foundry was placed in operation and, basing an opinion on the amount of space filled in, it is apparent that many years will elapse before it will cease to serve as a dumping ground.

Each cupola is provided with seven, 5 x 9-inch tuyeres connected to individual upright pipes that terminate in a bustle pipe or windbox after the manner usually employed in blast furnace construction. The general layout and distribution of the tuyeres is shown in Fig. 2 and the detail of construction is fairly obvious in Fig. 3. In the plan view below the wind belt shown at the top of Fig. 2 the center line of the seven tuyeres is indicated. It will be noted that the circumference is divided into eight equal spaces with a tuyere at each of seven spaces and with the eighth tuyere omitted on account of the chamber between the two cupolas. The chamber also is responsible for the high wind belt. The chamber cover is removable. It is lifted by a chain suspended from a short monorail and may slide back and forth. Sufficient clearance is provided under the wind belt to facilitate this operation.

Brick Lined Chamber

The brick lined chamber connecting the two cuoplas is the distinctive feature of the melting installation. The frame is of steel plate construction erected on a plate that forms a continuation of the cupola bottom plate and also flush with a steel platform which extends all around each pair of cupolas. The cupolas are in operation 8 hours a day and the platform is for the convenience of the cupola tender while inspecting the tuyeres through suitable peep holes.

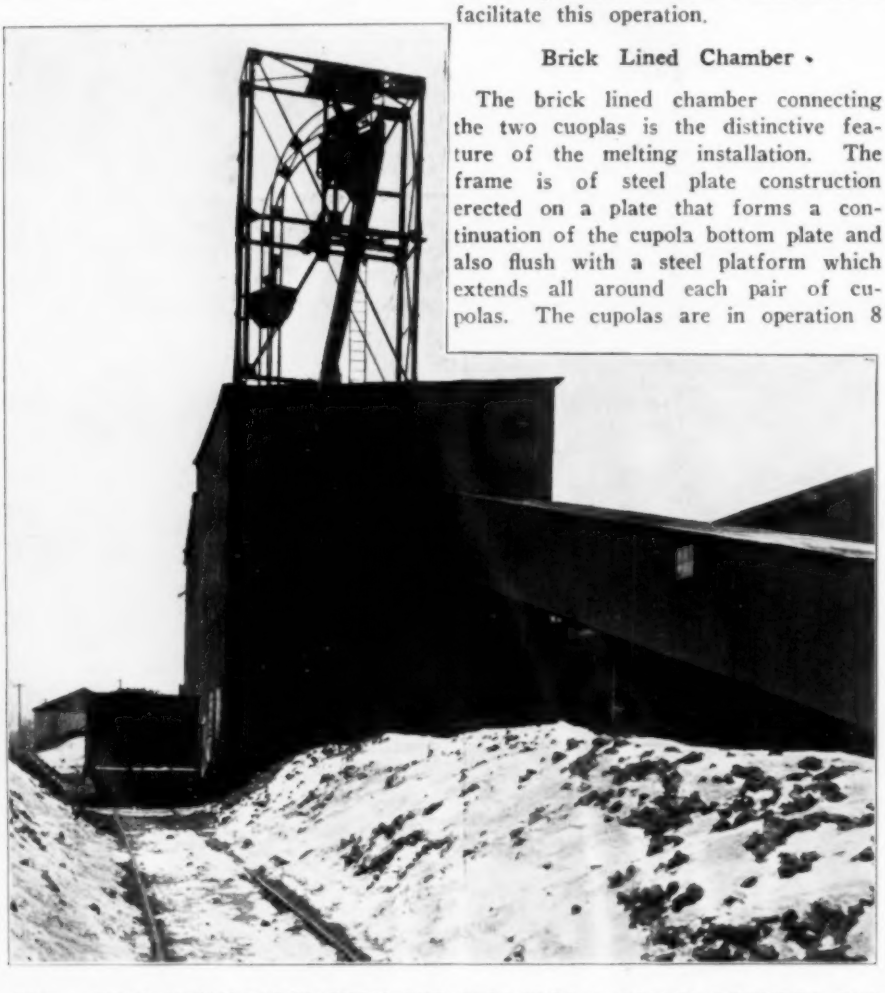

FIG. 5—COKE IS UNLOADED FROM THE CARS INTO A HOPPER BETWEEN THE RAILROAD—TRACKS FROM THE HOPPER IT IS CARRIED ALOFT BY A SKIP BUCKET AND DISCHARGED THROUGH A LONG PIPE ON TO THE CHARGING FLOOR

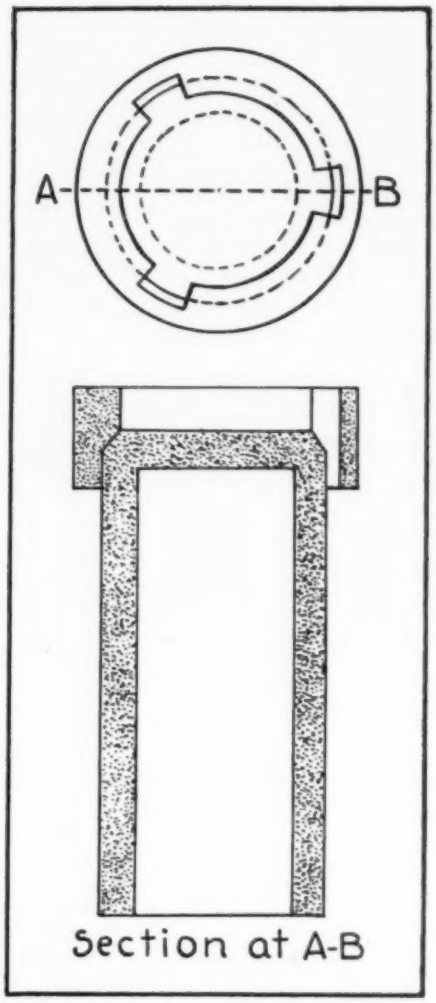

FIG. 6—PLAN AND SECTIONAL VIEWS OF CENTER AND RING CORES

The cupolas present a straight shell 78-inch diameter up to 2 feet above the charging door. At that point the shell is contracted to 58 inches and is continued at that diameter for 20 feet, or until it projects well beyond the roof. Various thicknesses of brick lining have been tried from time to time, but the present lining which gives an inside or operating diameter of 52 inches, seems to yield the most satisfactory service. The chamber between the cupolas is bricked to form a space 18 inches wide, 30 inches high and 6 feet in length between the opening in the lining in one cupola to the opening in the lining of the other cupola. The roof of the chamber is arched except for a space 16 inches long in the center where an opening is carried to the top to form an entrance for the repair man. A brick lined cover shown to the right in Fig. 2 closes the opening and conserves the heat in the chamber when the cupolas are in operation. The chamber is provided with a tap hole in front and a

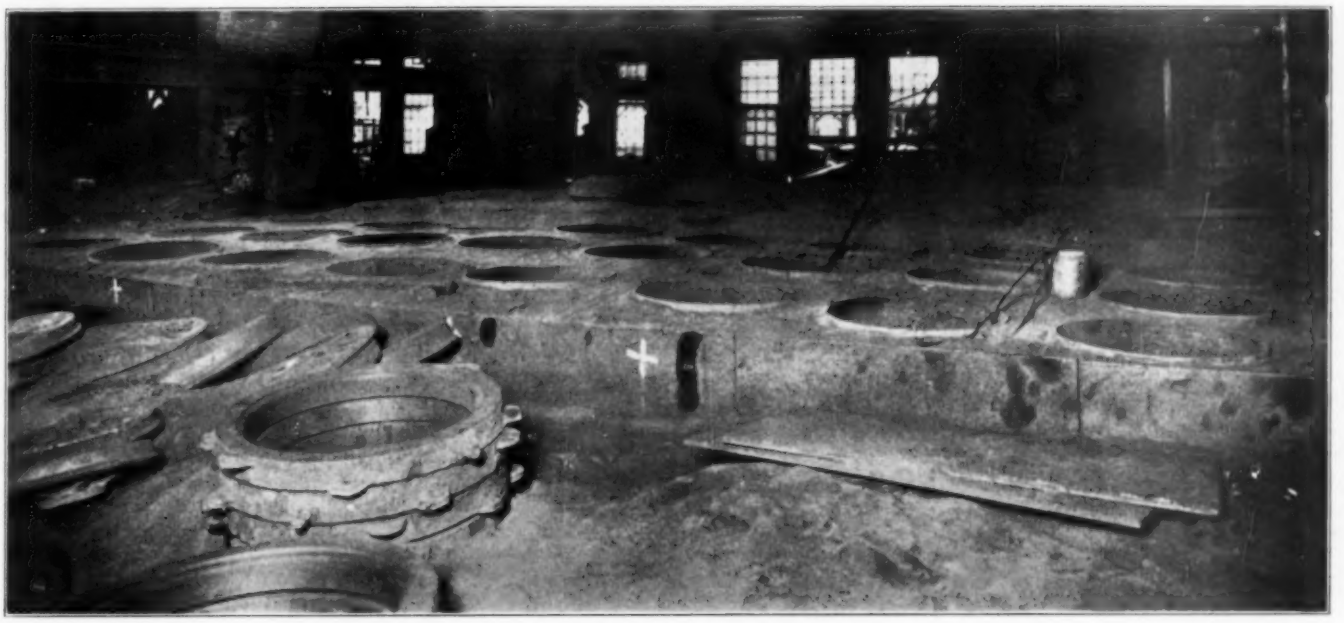

FIG. 7—ONE BATTERY OF 72 ANNEALING PITS, EACH PIT WITH A CAPACITY OF 16 WHEELS—A RESERVE BATTERY OF 40 PITS IS LOCATED DIRECTLY IN THE REAR

slag hole at the back. The slag hole has been placed 15 inches above the bottom. When the iron approaches this point it is a signal to tap it in the ladle.

In the original installation each cupola was provided with a long spout in the usual manner with the single exception that instead of projecting through the wall of the molding shop at right angles, they came through at an angle that brought the noses almost together. The idea back of this design was that the two cupolas should be tapped simultaneously and deliver their metal into a common mixing ladle stationed in front for the purpose.

Later, when the chamber was provided in the center, the spouts were not removed. A third spout was attached in front of the tap hole in the chamber. This spout is shorter than the others and it is attached in such a manner that it delivers metal into one of the long spouts which conveys it to the ladle.

Pour Continuously

Since molding and pouring operations are carried on continuously all day, it is apparent that they must be synchronized to avoid confusion. This is true of any foundry. In a wheel foundry a third feature is added. The wheels must be stripped and placed in the annealing pits while they still are red hot. Therefore, the problem that confronts the car wheel foundryman is to regulate the melting speed of his cupola to meet the requirements of the men molding the wheels and those of the men engaged in shaking them out and placing them in the annealing pits.

The foregoing features are responsible for the 52-inch lining in the 78-inch cupolas. After a fairly extended trial period the management is satisfied that the speed at which metal is melted in these cupolas more nearly meets ideal conditions than any other that has been tried. It is conveyed to the various floors in a number of ladles similar to the one shown in Fig. 1. The foundry is operated on what is known as the straight line system, which means that the floor of molds is put up in a straight line instead of in a circle around a jib crane. The latter method was employed universally in the early days of the industry and some shops still retain it, but the foundries built in recent years are arranged on the

FIG. 8—EACH FLOOR OF 25 MOLDS IS SET UP IN A LONG CONTINUOUS ROW ON LEVEL RAILS—THE IRON IS POURED THROUGH A CIRCULAR BASIN ON TOP OF THE CENTER OF THE COPE—DETAIL OF THE CORE EMPLOYED FOR A RUNNER IS SHOWN IN FIG. 6

straight line principle and many have been converted from circular to straight floors.

Each cupola is charged in the following manner: An initial charge of 2300 pounds of coke is placed on the bed and is followed by alternate layers of iron and coke in the proportion of 3200 pounds of iron to 280 pounds coke. Including the bed coke in the total amount consumed, the ratio of coke to iron works out at approximately 1 to 10. Scrap marble is employed instead of the usual form of limestone for a flux. Air for the blast is provided by a belt-driven fan made by the B. F. Sturtevant Co., Boston, connected to a 75-horsepower motor. The fan delivers air to both cupolas at the rate of 12,000 cubic feet per minute and at a pressure of 8½ ounces. A record of the volume and pressure of the blast for each heat is obtained through instruments supplied respectively by the Bacharach Industrial Instrument Co., Pittsburgh and the Bristol Co., Waterbury, Conn. Blowing equipment is set up in duplicate and each set is employed on alternate days. With this arrangement one set always is ready in reserve in the event that anything should go wrong with the other. Both fans discharge into the same main pipe and the change may be effected with practically no loss of time. Each pair of cupolas melts 22 tons of iron per hour.

Chemical specifications issued by one prominent eastern railroad calls for wheels of the following analysis: Total carbon, 3.35 per cent minimum, graphitic carbon, 0.90 per cent maximum sulphur 0.17 per cent maximum, phosphorus 0.35 per cent minimum. The silicon content is not specified. This is fairly typical of the requirements of other railroads. The iron charges are made up of returned wheels with a sufficient quantity of pig iron to rejuvenate the metal and insure the desired analysis in the finished wheels. Every railroad turns in its worn out wheels in part payment on a new order and obviously, the relative proportion of pig iron and scrap is changed from time to time.

Scrap wheels and pig iron are stored in an extensive yard beyond one end of the group of foundry buildings. The pig iron is discharged from incoming railroad cars by hand and piled in ricks. The scrap wheels also are unloaded by hand. A plank runway is erected from the side of the car to the ground and the wheels readily are rolled on their rims to any desired point in the yard. A man with his hands protected by leather easily guides the wheel and keeps it in motion. The wheels have to be rolled rapidly to keep them upright and as a result two men will unload or load a car with wheels in an almost incredibly short time. This method of handling cold wheels is in use all over the plant, whether scrap or new wheels. Obviously other methods are required to handle the hot wheels.

The old wheels each day are rolled under a drop and broken into several pieces for convenience in loading into the charging boxes. These boxes, one of which is shown in Fig. 4, are mounted on four, roller-bearing wheels and are open on both sides. They operate on a narrow gage track which extends from the stockyard to the extreme end of the charging platform. A car is loaded with scrap and pig and shoved over a track scale where the load is adjusted correctly either by the addition or subtraction of part of the load. It then is pushed to the foot of an incline where it is attached to the end of a steel cable and pulled up to the platform by an electrically operated winding drum suspended at a height above the floor that will permit the car to pass underneath when the cable is released. Each car of charging material is dumped immediately upon its arrival in front of the cupola. A hook suspended from an air hoist is attached to a loop in a section of movable floor as shown in Fig. 4. The car is tipped to an angle of about 30 degrees and the charge slides into the cupola. In the event that the material does not lie approximately level, a man armed with a long hook at the opposite door, rearranges the pieces of scrap.

The single track in front of the cupolas divides into two lines at the top of the incline leading to the stockyard. A suitable switch or turntable at this point diverts the empty cars down one track while the loaded cars are pulled

FIG. 9—ONE OF THE LIGHTENING CORES FOR THE WHEEL IS SHOWN IN THE CENTER, A COREBOX IN TWO PARTS ASSEMBLED TO RECEIVE THE SAND IS SHOWN TO THE RIGHT AND A SIMILAR BOX FILLED WITH SAND AND STRUCK OFF IS SHOWN TO THE LEFT—THE SPIDER ON THE LEFT BOX IS PROVIDED WITH THREE OPENINGS THROUGH WHICH STEEL LOOPS ARE INSERTED IN THE SAND TO SERVE AS CHAPLETS

up on the other. The empty car runs down by gravity and takes the hook end of the cable with it. At the bottom of the incline the hook is transferred from the empty to the loaded car. The empty car is pushed by hand to the stock pile, switched to the other track, reloaded and pushed again to the foot of the incline. In this manner a comparatively small number of cars is sufficient to handle all the metal required for the heat. Four men perform all the necessary work on the charging platform. Three men attend to the iron and one man handles coke.

The outside of the cupola department showing the covered inclined runway for the iron and the skip hoist for the coke is shown in Fig. 5. The picture was taken at a time when a transportation tie-up seemed imminent and that accounts for the piles of coke on each side of the railroad track. Usually no coke is piled in the yard. It is stored on the charging floor which has a capacity of nine car loads or approximately three weeks supply.

The loaded coke car is spotted over an opening in the track and the contents are discharged through the drop bottom into a concrete and steel bin. The coke bucket on the skip hoist is lowered to a point along side the bin and is loaded by moving a lever which opens a gate in the side of the bin near the bottom. The operation of the bucket up and down the runway is controlled electrically by a pair of push buttons located near the foot of the skip. The hoisting mechanism is housed in a small room under the iron runway. This room is kept locked and with the exception of those in authority, no person is allowed to enter the building or touch the buttons.

The skip bucket automatically dumps its load into a rectangular funnel which forms the mouth of a long pipe leading to a hole in the roof over the space on the floor set apart for coke storage.

Coke for each charge is measured accurately and charged into the cupola by a long nose rectangular bucket with an open top and a long handle. The device is suspended from a monorail which extends from the coke pile to the fourth cupola in line. The coke charging door is on the opposite side of the cupola from the iron charging door and a suitable switch in the monorail directs the coke bucket to any one of the four cupolas. A short section of the monorail close to the coke pile is suspended in such a manner that it forms the beam of a scale. The recording part of the scale is mounted on the wall near by. The bucket has been designed to hold approximately 300 pounds of coke, but coke varies occasionally in size and weight and in that manner the scale furnishes a check on the amount loaded. The coke tender forks coke into the bucket until the scale pointer indicates that the correct amount is loaded. He then pushes the bucket along to the pair of furnaces in blast and pushes the long nose in through the doorway of each one in turn. By releasing a catch at the back of the bucket it tips forward automatically and discharges the contents. The man behind manipulates the long handle on the bucket in a manner that distributes the coke uniformly over each iron charge. The trunnions on the sides of the bucket are set back of the center of gravity when the bucket is loaded, but not so far back as to make it difficult to snap the catch back into place when the load has been discharged. From the fact that one man charges from 14 to 17 tons of coke per day it is apparent that the foregoing equipment is both rapid and efficient.

FIG. 10—AFTER THE CARRIAGE LOADED WITH RED HOT WHEELS ENTERS THE SPACE BETWEEN THE RAILS, THE UPRIGHTS AT THE NEAR END RISE AND LIFT THE WHEELS CLEAR OF THE CARRIAGE—THE CARRIAGE THEN IS RETURNED AND THE WHEELS ARE LIFTED BY THE CRANE AND PLACED IN THE ANNEALING PITS

Miscellaneous Work

A fifth cupola is provided near one end of the building for melting iron required for repair and equipment parts, plates, chills, flasks, etc. The charges for this cupola are lifted in an elevator and charged by hand in the usual manner practiced in the majority of foundries. It is used only once or twice a week.

The molding space in the foundry is laid out in 14 long straight floors that extend all the way across the building with the exception of the space occupied by a narrow gage track along one side for the buggy ladles and a second narrow gage track in the center for conveying the wheels to the annealing pits. Each floor is provided with a pair of rails laid level, straight and parallel and on these rails the wheel molds are placed according as they are made. Each floor also is provided with a traveling air hoist that does all the necessary lifting during the process of making the molds and later in pouring and stripping them. Two men, graded as molder and helper, make 25 wheel molds a day. The metal is poured through a round basin set above the center of the cope. The basin retaining ring is attached permanently to the cope and the basin is formed by placing a tapered block on top of the wheel hub and ramming sand around it at the same time the remainder of the cope is rammed. A ring core provided with three gaps 2 x 1-inch is placed on the hub of the pattern before the runner block is set in place. The center core in the wheel fills the opening in the ring core with the exception of the three gaps which serve for gates. Detail of the ring core and center core is shown in Fig. 6.

Three cores are placed in each wheel mold, the center and ring covering core already referred to and the core known

(*Concluded on Page 322*)

Making Long Life Molds

Details of Refractory Mixtures Which Give Satisfactory Service—Record of a Series of Tests Under Shop Conditions—Plaster, Paper Pulp, Ganister, Carborundum and Monazite Sand Among Materials Used

BY OLIVER SMALLEY

SEMIPERMANENT molds open out a new branch of the foundry industry which offers many advantages including reduced molding and cleaning costs, decreased establishment charges, increased output of sound castings, and the production of stronger and closer grained metal. In many cases the first cost is not a serious item and by selection of a plastic refractory possessing the requisite properties, semipermanent molds are economical for many small castings even where only a few of each kind are required. When they are wanted, it should be possible to make thousands of castings from the same mold. In the case of large castings, semipermanent molds may prove economical even if only two or three castings are to be made, as for example in the production of propeller blades, engine pistons, junk rings, hydraulic cylinders and rams, and machine-tool castings.

The published literature covering semipermanent molds gives little information about the plastic refractory mixtures on which the successful application of this process depends. The purpose of this article is to consider the properties required by refractories for the manufacture of these molds and to discuss the application of various successful preparations.

Properties of the Refractory

The properties required for a satisfactory refractory for semipermanent molds include the following: It should be sufficiently plastic to mold and to stand up to the desired form green; it should possess such texture as will enable it to take a smooth finish and the sharp details of the pattern; it should have little or no volume change on drying and baking; it should yield a hard, robust, porous mold, which has a low coefficient of expansion on heating; it should resist the chemical attack and erosive action of the molten metal; it should withstand rapid heating and cooling without spalling; it should possess a low heat conductivity; and the initial cost should be such that for repetition work it will show a saving over ordinary molding sands.

Setting hard with only a slight contraction after drying at 450 degrees Cent., plaster of Paris is a useful material for making fine ornamental castings, but on account of its fragility under influence of heat and rapidity of setting its use is restricted to castings of simple form in white metal, aluminum and its alloys, and common brass. It is of no use for high melting point brasses, bronzes, cast iron or steel. For long life work, plaster of Paris may be used in conjunction with suitable refractory fillers which do not impair the permeability of the mold to gas. Of these china clay, fine silica sand, suitably ground, fire clay, asbestos flour, and powdered chromite recommend themselves as possessing the necessary properties.

OLIVER SMALLEY is one of the most prominent of the younger foundry metallurgists and engineers in Great Britain. Born in 1891, he is a graduate of Sheffield university. He served six years as a chemist and metallurgist with Cammell, Laird & Co., Ltd., Sheffield. He is now engaged in private practice as well as being technical adviser to Sir W. G. Armstrong Whitworth & Co., Ltd., Newcastle-on-Tyne. Mr. Smalley holds the silver medal of the London City and Guilds institute and a diploma of distinction and honor in chemistry and metallurgy granted by the British board of education. He is the inventor of a turbine bronze, a substitute for rubber, and a wood distillation process, and is the author of numerous papers and essays on foundry and scientific subjects.

Plaster of Paris comes in three qualities, coarse-ordinary, fine, and superfine. For this class of work, the fine quality is most suitable as a facing and the coarse-ordinary as a backing. Mixture No. 1, tried by the author, consisted of 65 per cent plaster of Paris; 25 per cent china clay or asbestos flour; and 10 per cent fire clay, free from grit. A little cowhair is an advantage. Mixture No. 2 consisted of 10 per cent plaster of Paris; 36 per cent china clay; 50 per cent chromite; and 4 per cent sodium silicate. With mixture No. 1 all the ingredients should be mixed together in the dry state, in sufficient quantities for current requirements. As plaster can rarely be kept without absorbing moisture from the air, its power of setting decreases gradually and is lost after a time. Any attempt to mold with plaster thus spent will result in failure. To safeguard against this the molder will do well to test the setting power of his plaster on making up his mixture and to store it in tin containers in a dry place for future use.

Method of Mixing

About 8 parts of plaster mixture to 10 parts of water is a good combination. The mixture should be sprinkled rapidly with the hand into the water and stirred, until the plaster begins to stand in a heap above the level of the water. The stirring must be rapid but care should be taken to avoid bringing the stirring rod to the surface in order to prevent air bubbles from being formed. When the mixture is at creamlike consistency, the molds should be made without loss of time. The time of setting is 20 to 30 minutes. When set, the molds should be dried at 450 degrees for 10 to 20 hours according to size until all traces of moisture have been expelled; other-

wise the mold will blow on casting.

With mixture No. 2 the plaster of Paris, china clay and chromite should be mixed dry. The sodium silicate should then be stirred in the necessary quantity of water. Mix as for No. 1 except that a slightly thicker consistency is recommended. The setting time is slower than that of mixture No. 1 but it may be speeded up by heating at a low temperature. Drying should be finished at a dull red heat. Both mixtures are successful for repetition work in white metal, aluminum, and brass.

Paper Pulp May Be Used

Paper pulp is a cheap material containing 40 per cent or upward of clayey matter, with good molding properties and low volume change on drying. Extended trials by the author proved it a useful material for molds for low melting point alloys. Its use, however, is limited on account of the large quantities of carbonaceous matter it contains in the form of straw, esparto grass, wood cellulose, etc. It should be dried at 300 degrees Cent. before being used.

In principle, semipermanent molding is practiced in most foundries making large castings of simple form, such as lead pans, ladles, land and marine engine castings, etc., where only a refacing of the original mold is required. Owing to their high shrinkage on drying, fragility, and spalling on contact with the hot metal, the ordinary standard loams and molding sands offer little promise of development as a facing which will stand up to two or more casts. By the use of a specially strong refractory loam which does not contract and by well sprigging, a second casting presents no difficulties, while if suitably touched up three or more castings are possible from a single loam mold.

Although silica sands constitute one of the best known refractories for general high temperature work, they present much the same objection as special loams and molding sands. The principal difficulties which militate against their successful application are premature cracking of the more delicate parts of the mold, spalling, and surface disintegration. Defects also arise from the natural volume changes between 200 and 575 degrees Cent. on both heating and cooling, a feature of silica which does not disappear by high temperature firing or other treatment of the raw material in the first instance. Because of its low cost, however, an investigation was conducted to develop a siliceous refractory which would give a reasonable life when used in semipermanent molds.

The problem presenting itself was to eliminate the natural shrinkage on drying and reduce the volume changes on heating and cooling. Plastics made from silica sand mixed with natural or artificial fire clays, demanding considerable care in manufacture, being fragile and having a high shrinkage, did not show much promise.

Possibility of Ganister

Of the various siliceous substances examined, quartzite ganister was the most promising as a base material. This should be well ground up so that the whole passes through a ⅛-inch mesh sieve but should not show more than 50 per cent clay when washed out with water.

Details Are Given

SEMIPERMANENT or long-life molds possess many advantages to foundries which have a large amount of repetition work. If properly made they may be economical even where only a few castings are required. Up to date little has been published showing the exact composition of the refractory materials most suitable for making semipermanent molds. This article gives details of a practical nature which every foundryman interested in this subject will find useful. The exact composition of numerous refractory materials is presented, together with instructions for making up and using suitable mixtures. Most of the mixtures mentioned have been actually tried out under shop conditions. The author recently has completed an exhaustive study of semipermanent molds, the results of which are embodied in this paper written especially for THE FOUNDRY.

Mixture No. 1 consisted of ground ganister plus 2 per cent of sodium silicate. This proved an improvement on ordinary ganister, small quantities of silicate increasing both the strength and hardness without being derogatory to the refractory power. It proved successful for certain simple castings in aluminum and brass, although continued use with the latter alloy soon cracks the surface. For iron and steel it leaves much to be desired and is unsuitable on account of rapid surface disintegration.

Mixture No. 2 consisted of ganister plus 15 per cent of firebrick grog, 2 per cent of lime, and 3 per cent of sodium silicate. This mixture overcame the molding difficulties of No. 1, due to high shrinkage on drying, but it did not prove so durable in service.

Mixture No. 3 was made up as follows: Ganister, 20 to 40 per cent; coke dust, 10 to 20 per cent; silica sand, 50 to 80 per cent. This series of mixtures did not crack on baking and formed hard compact molds. The surface disintegration on repeated use was less than the previous mixture, although it has a tendency toward premature cracking which reduces its value. To overcome this defect, the ganister content was increased, the sea sand reduced, and the coke dust replaced by fire clay.

Mixture No. 4 is the outcome of this change. It consists of 40 to 50 per cent well milled ganister; 30 to 40 per cent crushed firebrick; 10 to 20 per cent fire clay; 5 per cent coke breeze; and 5 per cent cowhair. This dries with little or no volume change, yields hard, strong and durable molds, and gives remarkable service in the manufacture of brass and gray iron castings.

The molds should be constructed in a suitable metal framework, and supported with a liberal use of irons and sprigs. Drying should be finished at 600 degrees Cent. Facing for every casting is recommended and the best results will be obtained by means of a graphite mixture in kerosene or by deposition of carbon from a smoky acetylene flame, or from burning resin. An aqueous solution of graphite with china clay may be used but the mold must be dried for each cast. This material proved the most successful of the silica base refractories tried and several hundreds of small iron castings can be made from one mold.

Carbon Refractories

The phenomenal success of carbon refractories leads one to believe that the next few years will see the development of a carbon plastic which will go far toward solving the semipermanent refractory mold problem. At the present time the drawbacks to these materials are the difficulties of producing a dense, hard material with a low coefficient of expansion and contraction on heating and cooling without the aid of high pressure or high firing temperatures.

When bonded to make a plastic mold which will bake hard at a comparatively low temperature, natural graphite, because of its inherent softness and fragility, is less suitable as a base material than synthetic graphite, petroleum or retort coke. These materials were found to possess a distinctive field of their own in the construction of molds where only a few castings are required. For long life work all the mixtures tried proved unsuccessful on account of brittleness and the patching up which was necessary even on a mold of simple contour presenting sharp edges. Where a number of castings are required, how-

ever, from a pattern presenting flat faces or regular forms such as those of rollers, engine and oil-cooler covers, firebars, balance weights, plates, etc., the cope may be made of one of these carbon plastics profitably, saving the cost of new sand, sand preparation and handling, and the labor of making and preparing that part of the mold for each casting.

The following mixture proved successful for 20 to 50 castings: From 40 to 50 per cent of graded coke (retort or petroleum); 40 to 50 per cent of strong fire clay; and 5 to 10 per cent of china clay. A little cowhair or asbestos fiber is an advantage. Mix the whole to the desired consistency with water or a 3 to 8 per cent sodium silicate solution if greater strength is required.

Carborundum, a chemical compound of carbon and silicon produced under high temperature conditions, is a refractory which has received the attention of most experimenters in the search of a suitable plastic refractory. Carborundum possesses many distinct advantages over silica and fire clay. It has great strength under heat conditions, a low coefficient of expansion on heating—approximately one-third that of fire clay—and withstands sudden changes of temperature without spalling. Transmitting 117 per cent more heat than silica, it recommends itself where high heat conductivity is required and where rapid cooling of the mold for output is necessary. It is nonoxidizing up to temperatures of 1000 degrees Cent. For these reasons carborundum appears to be a substance of considerable promise.

Carborundum fire-sand, a cheaper material, is obtained from the outside of the crystalline zones of carborundum. It is a porous substance of widely varying composition, as follows:

	Per cent
SiC	73 to 86
SiO_2	4 to 20
Al_2O_3	1.0 to 6.0
Fe_2O_3	1.0 to 5.0
C	1.0 to 1.2
Ca	6.30

With such a fluctuating material, difficulties are encountered in the manufacture of suitable molds and while molds have been obtained which gave good service, using the finely powdered fire-sand bonded with fire clay and sodium silicate, it is a material which may be replaced by other substances.

Aluminum Earths Promising

Alumina, being one of the most refractory as well as one of the commonest natural earths, is usually one of the first materials tried for the manufacture of semipermanent molds and the results warrant special consideration. Ordinary calcined alumina, 70 to 99 per cent of Al_2O_3, bonded with 10 to 20 per cent of kaolin or 20 per cent of fireclay with or without the addition of special artificial bonds, proved weak and friable unless baked at an excessively high temperature. Both white and red bauxite—a natural hydrate of alumina—presented similar difficulties and the various mixtures tested, unless treated with considerable care, shrank and cracked badly.

Fuse White Bauxite

By fusing bauxite in a cupola using anthracite coal as fuel, a refractory is obtained possessing physical properties which remove these difficulties. The approximate composition of white bauxite before and after this treatment is given below:

	Before treatment per cent	After treatment per cent
Alumina	59.2	68.8
Silica	18.5	21.4
Tetanic oxide	3.5	3.85
Oxide of iron	4.7	5.25
Carbon	Nil	0.60
Combined water	14.1	Nil
Incipient fusion, degrees Cent	...	1950

The shrinkage of this material in drying is approximately 1 per cent. It is subject to little or no variation of volume on heating to high temperatures and is a good heat conductor, approximately 2.1 times that of fire clay. It readily makes up into a suitable plastic by the addition of water and may be purchased in various grades.

If used alone it should be dampened with water and applied to the pattern as ordinary molding sand, being allowed to dry somewhat before removing the pattern. When air dried it should be baked at a dull red heat. Sprigging is recommended.

Gear-wheel blanks, disks, and various medium sized gray iron castings have been made successfully in molds constructed in this material. It also proved successful for repetition castings in brass, bronze, and cast iron. Being highly refractory and withstanding sudden changes of temperature without cracking, there is no reason why it should not also prove successful with steel, although no castings have been made with this metal by the author.

The initial cost of fused alumina being somewhat high, attempts were made to cheapen it by mixing with china clay, fire clay and the addition of various synthetic bonds. Of these, a mixture of 30 per cent china clay, 10 per cent silica sand, and 60 per cent alumina bonded with a 2 per cent solution of sodium silicate proved satisfactory although this cheapened mixture did not prove as successful as the unadulterated material.

Asbestos means not extinguishable or unconsumable. Its Greek name alone justifies its consideration. Consisting of fine thread-like crystals whose cross sectional area is approximately one-thirtieth that of fine silk, it is a mineral which may be worked up readily into a plastic cement which can be molded to any form. Being voluminous and consisting of interlaced fibers, the finished molds are light, strong, tough and exceptionally resistant to surface disintegration, the commonest defect of molds made from granular refractories.

Mixture No. 1 consists of asbestos fiber dampened with a dilute solution of sodium silicate. Under pressure this mixture forms a hard durable mold and when baked is quite suitable for brass, bronze, and light alloys. If the fibers are short and it is worked up into a compact mass, this mixture may be molded by hand but leaves room for improvement.

Mixture No. 2 can be made by the admixture of suitable refractory fillers. The difficulty of molding is thus obviated and an improved refractory giving longer service at a lower initial cost is obtained. This mixture consists of asbestos, 2 parts; china clay, 0.8 part; silica sand, 0.2 part; and granular alumina, 1 part; to which is added 5 per cent of sodium silicate in water. This mold proved successful with light alloys, brass, and bronze. Facing is necessary. While not tested with cast iron it should prove successful.

Many castings presenting irregular contour can be molded in asbestos cements of this nature, that would require a special collapsible or other mechanism, if made in a granular refractory. Where output is of first importance, asbestos cements are at a discount on account of their low heat conductivity. Where cooling is required, this property is, of course, an advantage.

Oxide of zirconium, ZrO_2, is possibly the most refractory material known. Because of its exceptional heat resisting properties and resistance to fluxes and slags, its low thermal heat-conductivity and coefficient of expansion on heating, it would seem a very suitable material as a base for semipermanent molds.

Use Oxide of Zerconium

Oxide of zirconium, mineralogically known as baddelyte, is found in Ceylon, Sweden, Italy, Brazil, and America. The trade name "Zircite" is used to designate the commercial ore of Zirconia. It contains between 72 to 98 per cent of ZrO_2.

Molds made from powdered Zircite proved successful for the manufacture of both iron and steel castings. On account of the high initial cost in suitable powder form and the high shrinkage on drying, the cost of the finished molds was such as to question its su-

periority over any of the cheaper and more familiar refractories which have been considered.

For this reason attention was turned to "Monazite sand" a silicate of Zirconium. It exists in large deposits all over the world. After the extraction of the thorium and cerium a waste product is left for which there is little or no market. In this material we have a refractory already in suitable form at a comparatively low price. In appearance it is yellowish and has a bright greasy luster. It is exceedingly heavy, with a specific gravity of 5.2 and in bulk form it flows like a heavy fluid.

To test this material a series of blocks 2½ x 1 x 1-inch and of slabs 4 x 1 x 1-inch were made. The tests made included volume changes in making into molds; the coefficient of expansion and contraction in heating and cooling; the fluxing action of oxide of iron at high temperature, the refractoriness; and the strength.

Test Strength of Blocks

The maximum linear contraction and expansion observed on a series of blocks at 800 degrees Cent. was 0.002 and 0.008 inch respectively. The coefficient of expansion and contraction on heating and cooling was such that the block could be quenched in cold water from a bright red heat without cracking. The fluxing action of oxide of iron was ascertained by arranging the slabs in the form of a cube-shaped mold, which was subjected to repeated casts of both iron and steel. All the castings left the mold with a clean skin and there was no trace of attack of the hot metal. None of the slabs cracked under this severe treatment. Manhandling strength was ascertained by allowing the small blocks to fall from a height of 3 feet on to a cement floor. Firebrick blocks thus tested break on the first drop. The zircon bricks withstood an average of six falls and so strong were some of the molds that they could be dropped on the floor without damage. The molds exhibited no signs of softening at temperatures up to 1500 degrees Cent.

Molds made from this material are exceptionally dense and heavy. They can be manhandled with safety, patched up if necessary, while disused molds may be ground up and used over again. Zircon molds may be used successfully in the manufacture of many classes of castings, including gear blanks, and ring castings; automobile, locomotive and marine engine pistons; engine and oil cooler covers; propellers; machine tool castings; valve guides; tubes; pipes; shells; etc. They will show an effective saving compared with the ordinary sand mold.

Iron Melts Cold for Last Half of Heat

Question: The iron from our two cupolas, one lined to 78 inches and the other to 72 inches, comes hot for about seven or eight charges and then drops off to quite an extent. Sometimes it picks up again but as a rule it does not. The coke bed in each cupola is about 24 inches above the upper tuyeres when it has burned through. We use the same size charges in both furnaces, made up of 3000 pounds of pig iron, 2000 pounds shop scrap and 1000 pounds foreign scrap with 600 pounds of coke between charges. Both cupolas are run together and we melt 22 charges in one and 18 charges in the other. We have tried several ways to remedy conditions but so far have not succeeded and we shall appreciate any advice you may give us on the subject.

Answer: From the details submitted we should be inclined to say that all you have to do is increase the coke ratio between the charges. Instead of using 600 pounds use from 800 to 1000 pounds, this amount to be determined by experiment because all coke is not alike. Since your first iron comes hot it is evident that your bed is the proper height and since later on the iron does not come so hot it is natural to infer that there is not enough coke between the charges to maintain the bed at the proper height.

You say that you have tried various remedies and it may be that the fault lies elsewhere. It also is a well known fact that cupolas are peculiar at times, but taking the question by and large nearly all melting troubles arise from an improper ratio of coke to iron or an improper weight of charge in proportion to the diameter of the melting zone.

The coke bed should extend 28 or 30 inches above the tuyeres, this height of course to be determined after the bed has burned through and settled. In this connection it is pertinent to point out that in case upper tuyeres are employed the bed coke must extend above them the indicated distance.

A prominent automobile cylinder foundry uses 350 pounds of coke to each ton of iron. The charge for the 78-inch cupola is made up of 3 tons of iron to 1100 pounds of coke and the iron at the end of a 110-ton heat, after the cupola has been in blast for 8 hours, is as hot as during the first part of the heat. The cupola is slagged freely and blast is supplied at 16-ounce pressure.

A considerable difference in area exists between a 78-inch and a 72-inch cupola and therefore to expect satisfactory results it is evident that the relative charges of coke and iron in one should be larger than in the other. We should suggest that you try 5000 pound charges of iron in the 72-inch cupola with 700 pounds of coke between charges.

Offers Interesting Data on Casting Temperature

The effect of casting temperature on the physical properties of a sand cast zinc-bronze was the subject of a paper presented by Francis W. Rowe at a meeting of the British Institute of Metals held March 12 and 13, 1924 in the hall of the Institution of Mechanical Engineers, London.

The object of Mr. Rowe's investigation was to determine for practical service the best casting temperature to give the required mechanical properties to a gun metal of the following specified composition: Copper, 88 per cent; tin, 6 per cent; zinc, 6 per cent. The paper deals with the method of making the test bars, their chemical analysis, and physical properties by tables, charts and micrographs. These results are used to demonstrate that the casting temperature exerts a marked influence on the physical properties of the alloy and that the most favorable temperature is clearly marked in this series of test. The yield point of the alloy shows no appreciable variation at the temperatures ranging from 1020 degrees Cent. to 1210 degrees Cent. The brinell hardness figures rise in proportion to the fall in casting temperature, which is common to all classes of bronzes and gun metals. Mr. Rowe infers that it is quite probable that test bars of different sizes might give appreciably different results and a uniform range of casting temperatures are applicable only to castings of similar section and molded under similar conditions.

Plan New Foundry

The W. K. Henderson Iron Works & Supply Co., Shreveport, La., has plans for the construction of a modern foundry unit just outside of the city limits of Shreveport. With the removal of the foundry department, the machine shop, mill supply department and saw mill assembly department will be able to expand into the buildings at present occupied by the foundry. Complete modern equipment will be installed throughout, the equipment contemplated including two electric steel furnaces and two gray iron cupolas. Frank D. Chase, Inc., is in charge of design and layout and the building will be constructed by the Leonard Construction Co., Chicago.

Casting Manganese Steel--II

Heat Treated in Electric Furnaces—Quality of Metal Determined by Bending Test Piece—Details of Molding and Handling Track Work—Pattern Shops Fitted with Long Benches

BY H. E. DILLER

HEATING temperature of manganese steel castings must be held close to 1000 degrees Cent. and the castings must be soaked in the furnace until an even temperature throughout is attained. The quenching water usually is held close to room temperature. One foundry made exhaustive tests using all temperatures from the boiling point of water to near the freezing point attained by cooling a bath of brine with ice. The conclusion from the tests was that 60 degrees Fahr. is the best temperature for a quenching bath.

Pyrometers are applied almost universally to heating furnaces for manganese steel, to insure that the metal will be heated to the correct temperature before it is quenched. If the temperature is not high enough the metal will not be softened sufficiently, while if the temperature is too high the metal is apt to be burned and will crack. In some cases electric heating is employed in an endeavor to secure a more even temperature. Fig. 1 shows a typical electric furnace used for heating smaller castings in several manganese steel foundries. A similar furnace is located at the side of the heat treating furnace shown in the first article of the series.

As indicated in the illustration, the furnace is of the single-end car type. The car is pulled from the furnace by the operation of an electric motor. The control apparatus is on one side of the furnace and a brake is provided at the front for use in case of emergency. The workman in the illustration is shown operating the brake lever. The furnace is heated by electric current passing through granular carbon resistance material in two carborundum troughs 10 inches high, 14 inches wide, with 2-inch walls located, one on each side, on brick piers. The electrical connections are made with buss bars on both sides of the furnace and at each end of the trough. One of these bars is shown at *A*, Fig. 1. Two small doors, one of which is indicated at *B*, are provided in the front of the furnace on a line with the top of each resistance box. This enables the furnaceman to add resistor material to the resistance box as it is required to replace that lost by the oxidation of the carbon in the box. A scoop attached to a long handle serves to introduce the carbon along the entire length of the box. A section of one of the resistance boxes resting on the brick piers may be seen at *C*, Fig. 1.

Smaller castings are introduced into the furnace in steel boxes as shown in the same illustration, while the larger castings are laid on cast-steel grids, one of which may be seen at the right of the box. Thus, when the car is pulled from the furnace the castings readily can be lifted off the platform of the car by the crane and a new charge set on and placed in the furnace with only a small loss of heat.

Naturally in the production of a metal requiring such a high degree of metallurgical skill and close control the laboratory plays an important part and all producers of manganese steel operate laboratories, both chemical and physical. Usually the physical laboratory is equipped with a tensile testing machine, a hardness tester and a machine for making bend tests. Heating furnaces are maintained in the laboratory for heating samples which when heated for a long time at about 700 degrees Cent. become soft enough to be drilled for analytical samples.

The chilling properties of manganese steel together with the color of

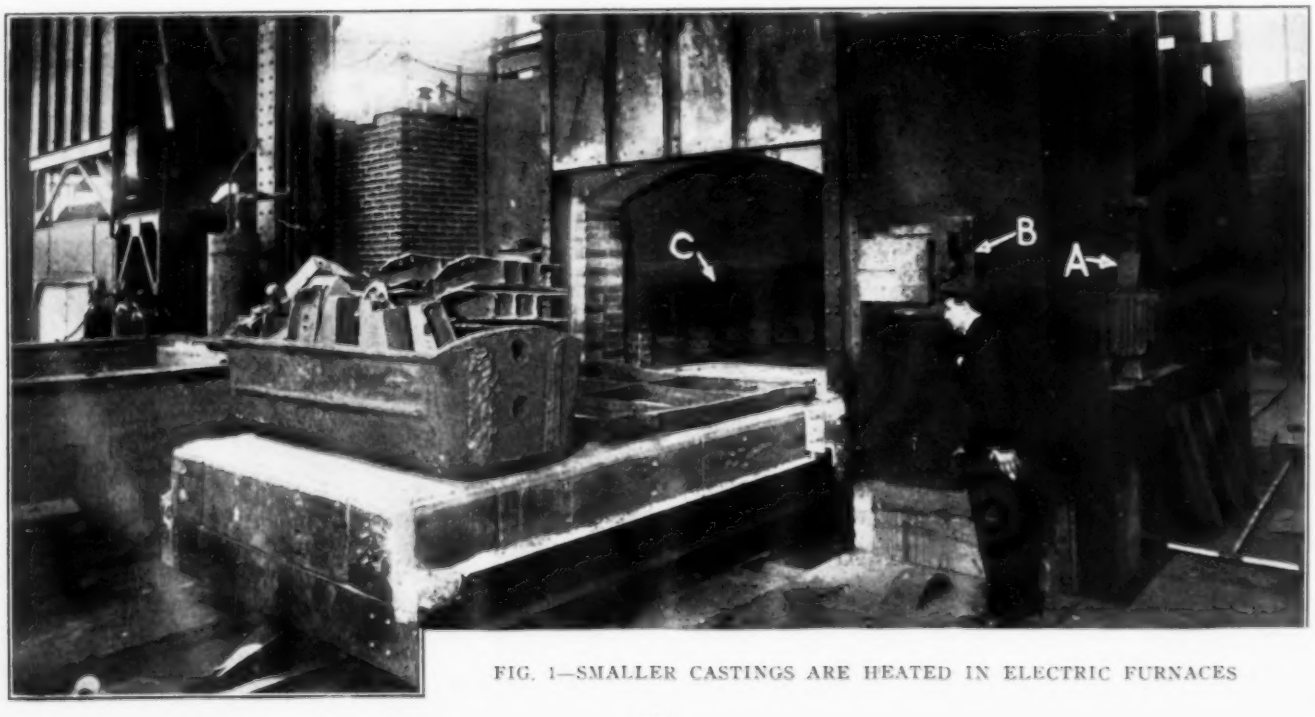

FIG. 1—SMALLER CASTINGS ARE HEATED IN ELECTRIC FURNACES

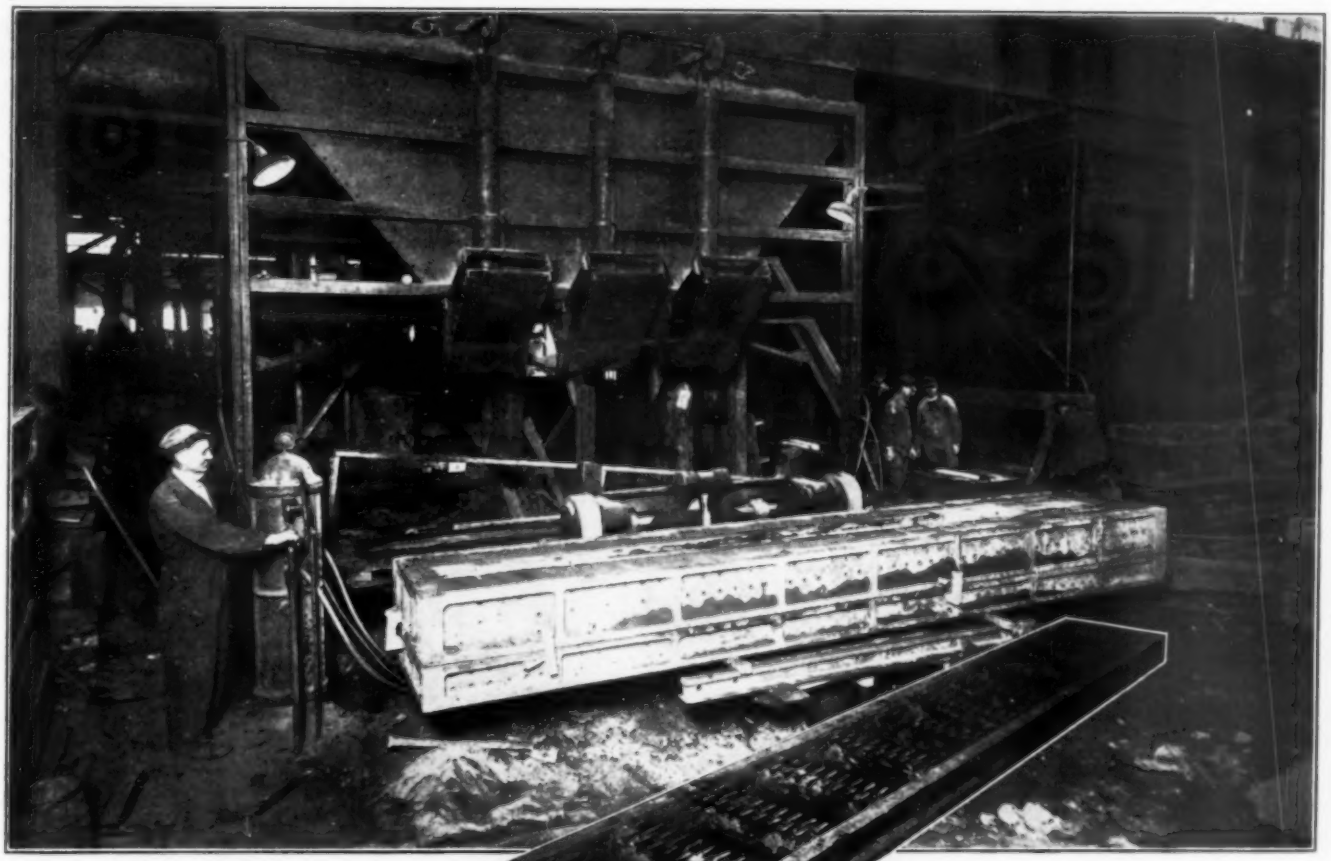

FIG. 2—A LARGE ROLLOVER-JOLT MACHINE MAKES THE DRAGS FOR TRACK CASTINGS WHILE THE COPES ARE MADE ON A PLAIN JOLT MACHINE—NOTE THE COPE FLASK IN FRONT OF THE DRAG MACHINE—THIS FLASK IS EQUIPPED WITH SPECIAL CROSS BARS FOR SUPPORTING THE SAND

FIG. 3—BELOW—PATTERN AND DRAG FOR A REPLACEABLE FROG CENTER—THE CYLINDRICAL CORES ARE FORMED OF SHEET STEEL TUBES FILLED WITH SAND—THE STEEL STAYS IN THE CASTING AND PRESENTS A SURFACE SOFTER THAN MANGANESE STEEL, THUS ALLOWING THE HOLES TO BE REAMED

the fracture are utilized to determine approximately the percentages of manganese in the metal before it is tapped. If the manganese steel is of the correct composition it will stand a certain amount of bending when cold. Poured into a chill mold a piece of thin section will act like a heat-treated piece of manganese steel. This test is used in electric furnace melting practice to determine whether the composition is correct before the metal is poured. One foundry casts a bar ¾-inch square, 12 inches long with well rounded corners. This bar is bent until both ends touch and then it must stand having the ends separated slightly without breaking. When it is broken the fracture is examined for color and texture. In this connection it is interesting to note that a sand-cast section ½-inch thick usually will bend 45 to 90 degrees before breaking. A section 2 inches thick, after it becomes cold usually breaks before it deflects 20 degrees. The thinner section is whiter, has smaller crystals, and is softer than the heavier section. However, if the two are heated to 1000 degrees Cent. and quenched the hardness of the two pieces will be approximately the same.

On account of the great hardness of the castings as they come from the molds and their characteristics after heat treating the cleaning problems are different from those of the foundry making carbon steel castings. Usually risers and gates can be necked

down, so that they can be broken off by a blow from a sledge. Great care must be used in doing this to prevent cracking the casting. In cases where the riser cannot be broken off it is cut off with an oxyacetylene torch. This must be done before the casting is heat treated as the metal becomes hard again when heated above 370 degrees Cent. Castings are repaired by welding after they are heat treated, but in such cases the castings are heat treated a second time.

Little attention is paid to the sand on the castings as they come from the mold as it usually is knocked off quite readily. What does not come off before the castings are quenched and the core holes cleaned thoroughly before the castings are put into the annealing ovens.

All foundries producing manganese steel castings are equipped with a large number of different kinds of grinding machines, both in the rough cleaning department and in the finishing or machine shop. The machine shop is equipped with different types of lathes and planers, but these machines all are fitted with grinding wheels instead of cutting tools as the latter will not stand up for cutting manganese steel. Fig. 5 is a general view of the rough cleaning department in a foundry making manganese steel castings. Grinding wheels are located

Few repeat orders are received for track castings of the same pattern. This is owing to the wide diversity of curves and the requirement that the casting meet the special need in each case. Firms engaged in the manufacture of this class of castings have large layout floors on which the patterns and track templets are laid out to permanent lines giving curves of different radii. After the castings are made and the rails bent they are assembled in their proper relative position in a layout yard covered by one or more cranes. In this manner it is possible to bend all castings and rails to exact shape before they are sent to the customer who is assure

FIG. 4—PATTERN BENCHES ARE ARRANGED SO THAT THE PATTERNMAKERS CAN WORK ON A TABLE BETWEEN TWO BENCHES—NOTE THE LONG PATTERNS WHICH ARE HANDLED

scales off during that process. However, great care is taken in the preparation of the facing sand. A highly refractory sand is employed which is well mulled and will not fuse readily to the face of the casting. Usually a portion of used sand is mixed with the new sand for facing together with a small amount of fireclay. Different types of mixers are used. Fig. 7 shows a typical installation in which the sand is dropped into the mill by gravity and when milled falls into a bucket set in the pit shown in front of it, to be carried to the molding floors by the crane.

Frequently castings when they are taken out of the sand are put in heated ovens, or pits, to cool, as they would cool too quickly if allowed to remain in the open air, or even if buried in sand. The castings are taken from the cooling furnace while they are still above 100 degrees Cent. and the gates, risers and nails are broken off in rows close to the columns on both sides of the central section. Each wheel is served by a jib crane with a chain fall operating on a trolley on the beam of the crane. A swing grinder as operated in another manganese steel foundry is shown in Fig. 6.

Straightened Cold

The castings must be straightened cold as heating to above 370 degrees Cent. causes the metal to become hard again, as has been previously noted. For this reason powerful presses are required for the larger castings. The smaller ones can be straightened under a drop hammer.

One line of work distinctive to the manganese steel foundry and which has contributed greatly to building up this industry is the production of castings for railroad tracks. Therefore this phase will be dealt with in considerable detail in this discussion.

that the rails and castings will fit to form the curve according to drawing without any changes when applied on the job.

The manufacturer of track castings also prefers to make his own patterns as the shrinkage of manganese steel is higher than that of ordinary steel and the shrinkage allowance is sometimes incorrect when the pattern is made in a shop where the workmen are not entirely familiar with this class of patterns. Then, too, the outside shop is frequently not advantageously equipped to produce these patterns which require long bench space and special skill on the part of the patternmaker. Usually the patternmaker receives a full-size plan drawing of the patterns, together with numerous cross-sectional diagrams. In a typical shop the patternmakers' benches are set back to back with a large layout table between two facing benches as shown in Fig. 4. The

patternmaker shown at the right of the bench is working on a hard center of manganese steel for a steam railway frog. The workman at the left is changing an old pattern of a manganese steel switch. It is apparent that a large pattern shop is required in a foundry doing this class of work, because hardly any two curves or crossings are exactly alike and new patterns or changes in old patterns must be made for nearly every job.

Attached by Dowel Pins

In some cases patterns are put on a narrow strip of board which can be inserted in the pattern board, which is bound around the sides with a strip of steel, thus saving the expense of making an entire pattern board for each pattern. In other cases the halves of the pattern are attached to the pattern board by dowel pins. Solid patterns are made for bedding in the sand.

Many of the molds are made on large jolt machines built for this purpose. In one case two machines are used. The one on which the copes are made is a plain jolt machine with a lifting capacity of 26,000 pounds. The table, 17 feet 6 inches long and 3 feet wide, is made of I-beams and will carry a flask 19 feet long. The machine for making the drags is of the rollover-jolt type, of 12,000 pounds lifting capacity. The table is the same size as that of the cope machine. Fig. 2 shows the drag machine with a drag rolled over and the table swung back into place. The bottom board is a steel casting, flat on the face which rests against the mold while the opposite side is fitted with four ribbed walls similar to the walls of a flask, only not as high. This feature may be noted in the illustration, Fig. 2, which also shows the sand hopper from which the sand is introduced into the mold through the three chutes shown turned up. The pattern in this case was attached to the pattern board with dowel pins and remained in the mold to be drawn by the molders.

Hanging Cores in Cope

The cope with its hanging cores is made in a flask equipped with special cross bars, formed by nicking the lower edge of a steel plate at intervals of about an inch then bending over the fingers, the one in one direction and the next the opposite direction. This construction is shown by the insert, Fig. 2. The cope of a switch mold contains hanging greensand cores which easily are supported with a few wooden *soldiers*, when this type flask is used. The fingers on the crossbars are on the joint side of the flask. All flasks used on the machines are fitted accurately with dowels, in reference to each other, and to the pattern boards, so that a close joint can be made. Another way in which this same purpose is accomplished by another firm is by putting the core section in the drag. Then instead of hanging in the cope it stands up as part of the drag. The drag is made on a pattern board with pockets for the core section. The back of the board is attached to a flask section which protects the protruding parts.

Besides the type of jarring machines shown in the illustration, jarring machines are used with the table flush with the floor. In one foundry a machine is being tried out, which makes the mold by throwing sand into the flask.

One might be justified in assuming that machines like the one shown in the illustration, handling flasks up to 19 feet in length, would be large enough to take care of any length pattern in the shop, but some switches are too long to be handled even by these great machines. Switches are made 20 feet 6 inches long with a ⅞-inch thickness of metal at its thinnest section. These castings are poured from a ladle with a 3-inch

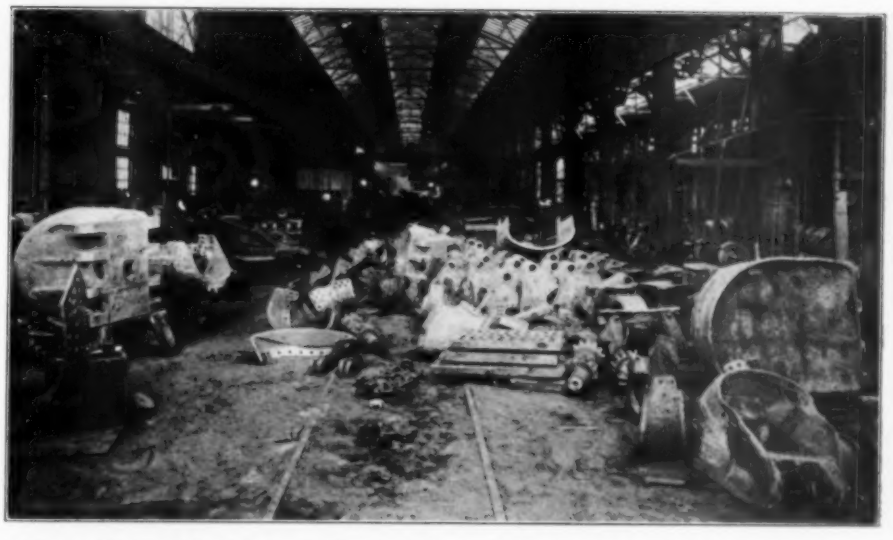

FIG. 5—GENERAL VIEW OF THE CLEANING DEPARTMENT OF A MANGANESE STEEL FOUNDRY

FIG. 6—SWING GRINDERS PROVE USEFUL IN REMOVING THE FINS ON MANGANESE STEEL CASTINGS

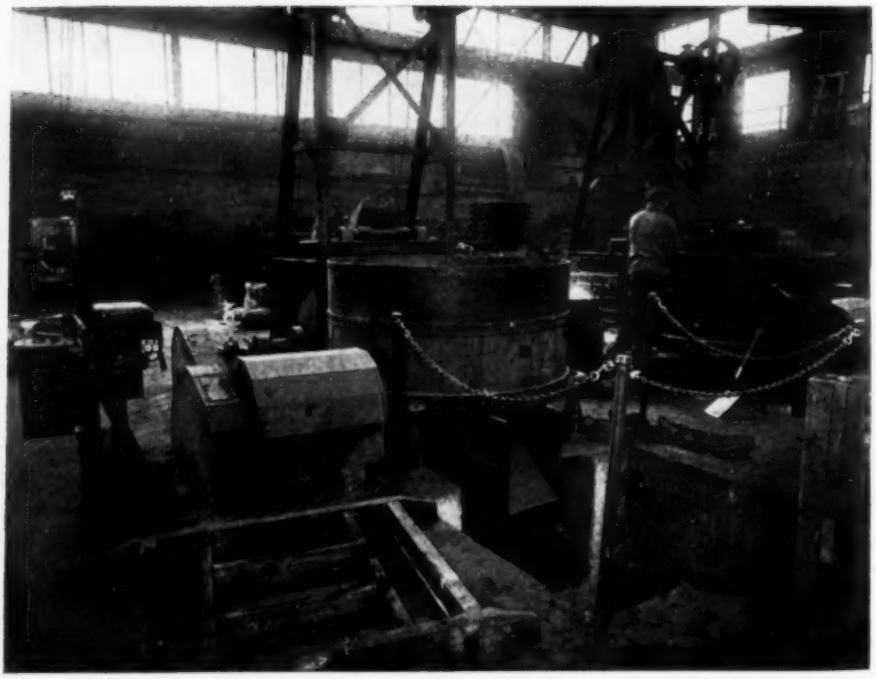

FIG. 7—SAND MIXING EQUIPMENT IS ESSENTIAL IN A MANGANESE STEEL FOUNDRY WHERE SPECIAL ATTENTION IS PAID TO THE QUALITY OF THE MOLDING AND CORE SANDS

nozzle. Molds for such castings are made in the usual manner by hand on the floor. If the pattern is solid it is bedded half way by the usual method and the cope set on. To bed in the pattern it is necessary to raise it after it is first bedded in and form the sand for the rail grooves by hand, then bed the pattern in a second and sometimes a third time. With certain shapes it is practical to fill the groove with sand and *flop* the pattern on a prepared level bed.

Another interesting casting made of manganese steel is the replaceable frog center, the pattern and drag of which is shown in Fig. 3. A unique feature of this mold is the steel-coated cores for bolt holes, shown in the illustration as a number of cylinders lying across the mold. To form these cores sheet steel is rolled in cylindrical form and filled with sand which later is dried. The object is to have the inside of the bolt hole of a soft metal which can be machined to secure the proper diameter, manganese steel being too hard for this purpose. The two larger cores shown together a little to the right of the center of the mold form holes for the rails to fit into. The ends of the rails are imbedded in gray iron which is cast around them and holds them in position. The gray iron casting also forms a bed for the manganese steel center casting. The latter is set in place and the space between it and the gray iron casting is filled with molten zinc, which when solidified holds it in place. The object of this construction is to allow the center casting which receives the severest wear easily to be replaced by melting the zinc which has a much lower melting point than iron.

Cast Window Weights in Permanent Molds

Question: We will appreciate any information you can supply on the subject of chill molds for sash weight castings, how they are made and how they are operated. We have done some experimenting but have not been able to clamp the molds tightly enough to prevent a fin at the joint line of the castings. We should like to know what other manufacturers have done along the line of permanent molds to guide us in further experimental work. Also we shall appreciate your opinion on a suitable analysis for the iron forming the molds and the anticipated life of the mold.

Answer: Your initial mistake has been in attempting to pour several castings in a single multiple mold at the same time. The mold will spring in the center irrespective of how tightly it is clamped or even bolted along the edges. This is inevitable. The center is heated and the edge is not heated when the mold is filled with molten iron. As a result the center buckles and you cannot prevent it unless you make a mold so heavy that it will absorb the heat without causing distortion. Edgar A. Custer, demonstrated this point conclusively in his extended series of experiments with permanent molds at Tacony several years ago. He presented a paper on the subject before a convention of the American Foundrymen's association in Cincinnati in 1909. The paper was published in THE FOUNDRY June, 1909 and also is incorporated in the *Transactions* of the association for that year.

Sash weights are cast in batteries of single water cooled iron molds split through the center and set up vertically in shallow pits. Two batteries are set in each pit and are served by a common water pipe laid on the floor between them. The back half of each mold is connected by a short length of small pipe to the main pipe. Water is conveyed to the front half of the mold through suitable hose connections that permit the opening of the mold to remove the casting. The molds are hinged at the back and clamped in front by a pair of hinged levers attached to one half provided with cams that engage suitable projections on the other half. When swung into position they lock automatically. The molds are poured one at a time and by the time the ladle has gone around the battery, the first castings have been removed and the molds again are ready to be filled.

The mold castings are made from iron of approximately the following analysis: Silicon 2.25 per cent, sulphur, phosphorus and total carbon fairly low and manganese about 0.70 per cent. With proper care the chills will last for many years.

British Foundry Show

It was reported at the end of March that about 40 applications for space had been received by the managers of the International Foundry Trades exhibition which will be held in Birmingham, England, June 19 to 28. This exhibition will be held in Bingley Hall where the successful 1922 show was staged. Lord Weir, head of G. & J. Weir, Ltd., Cathcart, Glasgow, again is president of the exhibition, the patrons of which will include the Institute of British Foundrymen, British Cast Iron Research association, and other prominent technical organizations A series of lectures on foundry subjects will be given during the exhibition and a number of competitions designed to promote the arts of molding and pattern-making will also be held. The exhibition is in charge of Charles Stanley, general manager of the exhibition department of the Birmingham Chamber of Commerce.

The Whiting Corp., Harvey, Ill. has been appointed sales agent for the Swartwout Co., Cleveland, maker of insulated steel core ovens.

Describes Foundry Cost Plan

Methods Employed in Obtaining Cost of Production Based On Expenditures Covering Raw Materials, Melting and Molding Consider Good and Bad Castings Produced, Also Shrinkage Loss

BY THOMAS PERKINS

COSTS are receiving much attention among foundrymen at present, owing to keener competition which necessitates closer figuring of selling price. A system for obtaining accurate figures covering the actual cost of production is absolutely essential to enable the foundrymen to place a correct selling price on his product. Such a system, regardless of what kind it is, should be worth the expenditures involved in its installation, and maintenance. The more simplified and accurate the system is, the more serviceable and satisfactory it will prove. Such a system is explained by the accompanying tables and charts.

Table I shows the actual cost of material when in storage. This starts at the bottom, giving a chance to watch the detail work and also demonstrates how the different expenses wind themselves into actual cost. It will be noted that the figures used in this statement are not actual but estimated, this being done to simplify the figures as much as possible in making calculations. This statement shows total cost per ton of pig iron, scrap iron, scrap steel, and coke. giving costs per ton at the furnace ovens or place of purchase, cost of freight per ton, also, cost per ton of unloading and handling to storage place. From this the cost per ton at the furnace and ovens or place of purchase, also freight charges per ton from the invoices and freight bills may be obtained. In order to get cost per ton of unloading and handling to storage place, an order must be issued the same as a sales order, giving car number, number of tons, etc. As soon as this work has been completed the cost sheet is compiled which gives total cost of unloading and handling. Divide this amount by the number of tons and obtain the cost per ton. The same results may be obtained in another way by having one nonproductive number for unloading stock, each time car showing, just what stock was unloaded. This order will be worked up each month and separated, that is, giving each department its share of the expense. In this way it is thrown in the overhead.

Eliminate Guess Work

AN ITEMIZED cost sheet is essential in obtaining accurate figures covering the production of miscellaneous castings requiring more or less intricate core work. It is often the case that a flat figure is given to cover this work based upon an average cost carelessly obtained, and which in the end is the cause of serious financial losses.

Under such conditions it usually happens that the smaller castings with more or less intricate core work will be required which may raise the cost of production as high as 50 per cent over the flat rate given. The larger castings with little or no core work may be given to a concern who figured on this special line of work at a much lower figure after allowing a fair margin of profit.

Recognizing this condition, Mr. Perkins presents a plan which in its practical form may be adapted to overcome the flat rate per pound *evil.*

Fig. I, the Daily Metal Report is made out by the foundry clerk each day, giving total weight of pig iron, scrap and coke charge into furnace and total weight of good and bad castings, returns and shrinkage. From Table III, the first item dated January 1, provides these figures to fill out this form. On the left side of this form fill in 5400 pounds pig iron, 6300 pounds scrap iron, 6300 pounds scrap steel and 1700 pounds coke. Do not add the coke in arriving at the total weight of charge, but add only pig iron, scrap iron and scrap steel, which gives a total of 18,000 pounds. This amount was charged into the cupola. On the right side of this form place 12,635 pounds good castings, which is given in Table III same line, 1675 pounds bad castings, 3315 pounds returns and 375 pounds shrinkage. These figures when added should agree with the total weight of charge shown on left side of form.

To arrive at these figures, the foundry clerk has to weigh the good castings, bad castings and returns. The difference

Abstracted from a paper presented at the annual meeting of the Southern Metal Trades association, Feb. 26-29, 1924. The author, Thomas Perkins, is cost accountant for J. S. Schofield's Sons Co., Macon, Ga.

DAILY MELT REPORT

Date..... 192..

CHARGE	WEIGHT	PRODUCTION	WEIGHT
Pig Iron		Good Castings	
Scrap Iron		Bad Castings	
Scrap Steel			
		Returns	
Coke (Don't add)		Shrinkage	
Total Iron		Total	

Correct:

Foundry Clerk

COST OF CHARGE

DESCRIPTION		AMOUNT
Lbs. Pig Iron at	Per Ton	
Lbs. Scrap Iron at	Per Ton	
Lbs. Scrap Steel at	Per Ton	
Lbs. Coke at	Per Ton	
Cupola Labor		
	Total	
Less Lbs. Returns and Bad Castings (Re'cd)		
	Total Cost of Charge	
	Metal Cost per pound of Good Castg.	

Entered

Cost Department

FIG. 1—FORMS USED FOR RECORDING DAILY MELT, AND COST OF CHARGE IN FOUNDRY COST KEEPING PLAN

Table I

Cost of Material in Storage

Purchase price of pig iron at furnace	$28.00
Freight	1.50
Handling to storage	0.50
Total cost of pig iron per ton	$30.00
Purchase price of scrap iron	$15.00
Freight	1.50
Handling to storage	0.50
Total cost of scrap iron per ton	$17.00
Purchase price of scrap steel	$14.00
Freight	1.00
Handling to storage	1.00
Total cost of scrap steel per ton	$16.00
Purchase price of coke at ovens	$10.00
Freight	1.50
Handling to storage	0.50
Total cost of coke per ton	$12.00

Table II

Distribution of Overheads

DIRECT LABOR		$2,868.87
DIRECT OVERHEAD		
Nonproductive labor	1,271.97	
Supervision	316.55	
Liability insurance	54.61	
Repairs	154.50	
Supplies	794.18	
Miscellaneous	1.57	
Defective work	163.06	
General factory	285.28	
Power	88.55	
	$3,130.27	109%
INDIRECT OVERHEAD		
Depreciation	77.97	
Fire insurance	20.97	
Taxes	47.87	
General factory	94.80	
Power	11.89	
	$253.30	9%
TOTAL OVERHEADS FOR MONTH OF JANUARY, 1924		118%

between this figure and the total weight of furnace charge is shrinkage.

After this information has been tabulated by the foundry clerk the report, together with the time cards, is sent to the cost department. These cards are balanced with the melt report as to good and bad castings. The cards are then figured by each man's rate and are ready for the file. After this has been done, the cost of charge Fig. III which will be shown on the bottom of the melt report may be prepared. In recording the total pig iron, scrap iron, scrap steel and coke which is shown on the left side of the report, use the prices shown as follow: 5400 pounds pig iron at $30.00 per ton gives $72.32; 6300 pounds scrap iron at $18.00 per ton gives $50.62; 6300 pounds scrap steel at $16.00 per ton gives $45.00; 1700 pounds coke at $12.00 per ton gives $10.20. This will give the total amount of material. Cupola labor is regarded as nonproductive labor and always is charged to one certain number, this making it easy to separate this item from other time cards. The Scofield company's cupolas are operated with colored labor and use three men, except on light heats when this is cut down to two men. In referring back to Table III it will be noted that on Jan. 1 a charge of $10.33 was made for cupola labor. Add this to the total cost of material and the total cost of the heat for the day is the result.

To care for the returns and bad castings again refer to Table III. By adding these items a total of 4990 pounds results; this amount being nothing more than scrap iron it may be figured on the same basis of $18.00 per ton which will give $40.10 for the 4990 pounds. Deduct this amount $40.10, from the total cost of heats and the total cost of charge, which is $148.37, is obtained. To arrive at an average cost per 100 pounds for this day's heats, divide the total good castings 12,635 pounds into the total cost of charge $148.37 which will give an average of $1.17 per 100 pounds. To get the average shrinkage for the day, divide the total weight of heats 18,000 pounds into the total shrinkage 375 pounds, this will give 2 per cent shrinkage.

In Table III the statement showing cost of metal at spout for month of January 1924, is only a recap showing in detail each day's heat, also, totals and average for the month.

Fig. 2 the Analysis of Metal Cast is the same as given in Table III with the exception of a little more information, such as percentages of pig iron, scrap iron, scrap steel, etc. The circle in the top left corner shows total weight and percentage of pig iron, scrap iron, and scrap steel, this of course covers total weight of heats for the month.

The circle in the top right corner shows the total and the percentages of pig iron, scrap iron and coke, using

Table III

Cost of Metal at Spout for Month of January, 1924

Date	PIG IRON Weight	PIG IRON Amount	SCRAP IRON Weight	SCRAP IRON Amount	SCRAP STEEL Weight	SCRAP STEEL Amount	COKE Weight	COKE Amount	Cupola Labor Amount	BAD CASTINGS Weight	BAD CASTINGS Amount	RETURNS Weight	RETURNS Amount	Shkg. Weight	Good Cast'g. Weight	Total Cost Amount	Cost per 100 lbs.	Per Cent Shrinkage
January 1, 1924	5,400	$ 72.32	6,300	$ 50.62	6,300	$ 45.00	1,700	$ 10.20	$ 10.33	1,675	$13.15	3,315	$ 26.65	377	12,635	$ 148.37	1.17	2.9%
January 2, 1924	6,900	92.41	8,050	64.69	8,050	57.50	3,200	19.20	12.06	504	4.85	3,681	31.21	475	18,137	210.60	1.16	2.6%
January 3, 1924	6,900	92.41	8,050	64.69	8,050	57.50	3,200	19.20	12.57	210	1.69	3,751	30.16	456	18,580	214.52	1.15	1.9%
January 4, 1924	6,600	88.39	7,700	61.88	7,700	55.00	3,100	18.60	12.90	105	.84	3,736	30.02	526	17,639	205.91	1.16	2.3%
January 5-8, 1924	8,400	112.50	9,800	78.75	9,800	70.00	3,700	22.20	15.56	166	1.33	4,616	37.34	580	22,698	260.34	1.15	2.8%
January 9, 1924	6,600	88.39	7,700	61.88	7,700	55.00	3,100	18.60	11.56	692	5.56	4,246	34.12	545	16,517	195.75	1.18	2.4%
January 10, 1924	6,600	88.39	7,700	61.88	7,700	55.00	3,100	18.60	11.06	330	2.65	4,296	34.52	538	16,836	197.76	1.17	2.4%
January 11, 1924	6,000	80.35	7,000	56.25	7,000	50.00	2,900	17.40	10.56	70	.56	1,586	36.85	485	14,859	177.15	1.19	2.4%
January 12-14, 192 4	7,800	104.46	9,100	73.12	9,100	65.00	3,500	21.00	15.15	268	2.15	2,806	22.55	468	22,458	254.03	1.13	1.8%
January 15, 1924	6,000	80.35	7,000	56.25	7,000	50.00	2,900	17.40	11.56	700	5.63	2,541	20.41	391	16,368	189.52	1.15	1.9%
January 16, 1924	6,300	84.37	7,350	59.06	7,350	52.50	2,100	12.60	11.24	63	.50	3,974	31.94	411	16,552	187.37	1.13	1.9%
January 17, 1924	5,700	76.34	6,650	53.44	6,650	47.50	2,800	15.96	11.24	472	3.79	2,995	32.13	421	14,109	167.60	1.18	2.2%
January 18, 1924	6,000	80.35	7,000	56.25	7,000	50.00	2,900	17.40	12.56	—	—	3,497	31.32	397	15,706	185.24	1.17	1.9%
January 21, 1924	6,900	92.41	8,050	61.69	8,050	57.50	3,200	19.20	12.36	48	.39	3,615	29.04	488	18,849	216.73	1.14	2.1%
January 22, 1924	6,000	80.35	7,000	56.25	7,000	50.00	2,900	17.40	8.68	192	1.51	3,196	25.68	382	16,230	185.46	1.14	1.9%
January 23, 1924	6,900	92.41	8,050	61.69	8,050	57.50	3,200	19.20	10.56	486	3.90	4,271	31.32	496	17,747	206.14	1.16	2.1%
January 24, 1924	6,000	80.35	7,000	56.25	7,000	50.00	2,900	17.40	12.78	110	.88	6,679	53.67	465	12,746	162.23	1.27	2.3%
January 25, 1924	6,000	80.35	7,000	56.25	7,000	50.00	2,900	17.40	11.80	390	3.13	1,739	38.09	483	14,388	173.78	1.20	2.4%
TOTAL	117,000	$1,566.90	136,500	$1,096.89	136,500	$975.00	53,300	$319.80	$213.77	6,181	$52.01	72,179	$580.02	8,376	302,964	$3,538.50	1.16	2.1%

TOTAL WEIGHT OF HEATS	390,000 POUNDS
TOTAL WEIGHT OF GOOD CASTINGS	302,964 POUNDS
AVERAGE COST PER 100 POUNDS	1.16
AVERAGE SHRINKAGE FOR MONTH	2.1%
RATIO IRON TO COKE	7.3 IRON TO 1 COKE

COST OF MATERIALS

PIG IRON	$30.00 PER TON
SCRAP IRON	18.00 PER TON
SCRAP STEEL	16.00 PER TON
COKE	12.00 PER TON

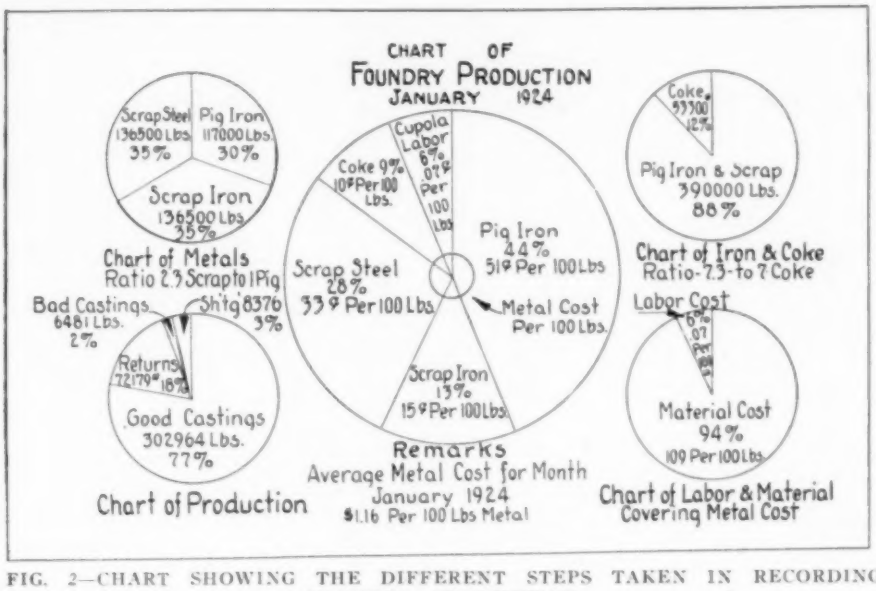
CHART OF
FOUNDRY PRODUCTION
JANUARY 1924
Scrap Steel 136500 Lbs. 35%
Pig Iron 117000 Lbs. 30%
Scrap Iron 136500 Lbs. 35%
Chart of Metals
Ratio 2.3 Scrap to 1 Pig
Bad Castings 6481 Lbs. 2%
Shtg 8376 3%
Returns 72179# 18%
Good Castings 302964 Lbs. 77%
Chart of Production
Cupola Labor 6% .07¢ Per 100 Lbs
Coke 9% 10¢ Per 100 Lbs.
Pig Iron 44% 51¢ Per 100 Lbs
Scrap Steel 28% 33¢ Per 100 Lbs.
Metal Cost Per 100 Lbs.
Scrap Iron 13% 15¢ Per 100 Lbs.
Remarks
Average Metal Cost for Month January 1924
$1.16 Per 100 Lbs Metal
Coke 93300 12%
Pig Iron & Scrap 390000 Lbs. 88%
Chart of Iron & Coke
Ratio-7.3-to 7 Coke
Labor Cost 6% .07 Per
Material Cost 94% 109 Per 100 Lbs.
Chart of Labor & Material Covering Metal Cost

FIG. 2—CHART SHOWING THE DIFFERENT STEPS TAKEN IN RECORDING FOUNDRY PRODUCTION

total weight of heats and total weight of coke for the whole figure. The large circle in the middle gives the metal cost per 100 pounds showing percentage and average rate per 100 pounds of each item going to make the total cost amount. To obtain this information take the total cost amount and average cost per 100 pounds from the monthly statement, and divide total cost amount into the total cost of pig iron, giving percentage average cost per 100 pounds of pig iron. Scrap iron is worked in the same way except for deducting the total cost of returns and bad castings from the total amount of scrap iron. Scrap steel, coke and cupola labor is worked in the same manner as pig iron.

The circle in the lower left corner gives production for the month. Use the total weight of heats for the month as the whole figure and work out the percentage of good castings, returns, bad castings and shrinkage.

The circle in the lower right corner gives percentage and average rate per 100 pounds of material and labor. Use the total cost amount from the monthly statement as the whole figure, deduct total cost of returns and bad castings from the total cost of pig iron, scrap iron, scrap steel and coke, then divide this figure by the total cost amount and obtain the percentage of material cost. By using this percentage of the average cost per 100 pounds an average rate per 100 pounds of material cost is found. Labor is obtained in the same way, dividing total cost into cupola labor, etc.

Table III, the statement of overhead gives you a total of direct labor in foundry for the month of January and also details each item of expense and its total.

Some may not understand just why two classes of overhead, direct and indirect are used. It will be noted that all items under the head of direct overhead are items that should be watched by the superintendent and foreman as these charges if not watched closely can run overhead much too high. All items under indirect overhead may be termed stationary as they are practically always the same. By adding both classes of overheads together the same results are found as by using them separately.

On account of overheads varying from one month to the next it is customary to use only the actual rate of overhead in arriving at actual casting cost. On figuring cost of sales an estimated rate, based on three years experience is used, this rate being checked monthly with the actual rate and changed only when deemed necessary by the assistant general manager.

Table IV shows Castings cost by floors for month of January. To obtain this information gather from the time cards each day the total number of hours worked both direct and indirect by each man, total pounds bad castings and total good castings. Before making this report each month the metal report has to be made to get the cost of metal at the spout. Also, it is necessary to have a statement from the bookkeeping department showing actual overhead for that month. After obtaining this information, the report is ready for compilation. To arrive at the direct labor cost, add the molder's and his helper's rate together and figure on his direct hours. The rest of the work on this report may be easily understood by analyzing the different items. Note that No. 115, 119 and 124 are apprentice boys, which accounts for their low casting cost, Nos. 102, 128, 134, 142 and 144 are molders handling the heavy class of work and the heavier the castings are, the lower the cost will be. No. 126, 133, 135 and 137, do the light work which runs their cost high. The remainder of the men take the miscellaneous jobs or the medium weight castings.

Table V is a statement showing cost of miscellaneous castings. From experience with sales work, it is desirable to keep the sales department posted with this kind of information, as practically all selling castings conceive the idea that the heavier the casting is the less it will cost to make and the lighter the casting the more it will cost to produce. This is correct, but it must be remembered that a number of castings made have more or less intricate core work and in some instances the core time is in excess of the molding time.

This report ranges from a 2-pound casting to a 660-pound casting giving molder's, helper's and coremaker's time

Table IV

Castings Cost by Floors From Jan. 1 to 25, 1924

Floor	Hours direct	Hours indirect	Total pounds	Bad castings	Good castings	Factory Cost—Metal	Factory Cost—Direct labor	Factory Cost—Burden	Factory Cost—Total	LB cost
102	151.1	35.6	17,119	166	16,953	196.65	140.52	165.81	502.98	2.96
115	143.5	31.5	6,913	108	6,805	78.94	35.87	42.33	157.14	2.30
119	113.0	27.0	9,040	...	9,040	104.86	22.60	26.67	154.13	1.70
122	160.1	34.9	15,052	530	14,522	168.45	144.09	170.03	482.57	3.32
123	160.2	34.9	14,010	510	13,500	156.60	144.18	170.13	470.91	3.48
124	139.2	30.8	8,326	36	8,290	96.16	34.80	41.06	172.02	2.07
126	115.6	24.4	6,240	424	5,816	67.47	101.73	120.04	289.24	4.97
127	160.1	34.9	8,495	105	8,390	97.32	99.26	117.12	313.70	3.73
128	152.1	32.9	22,992	836	22,156	257.01	129.28	152.55	538.84	2.43
129	160.0	35.0	16,138	723	15,415	178.81	136.00	160.48	475.29	3.08
131	160.1	34.9	12,975	92	12,883	149.44	131.28	154.91	435.63	3.38
132	119.0	25.0	11,348	1,400	9,948	115.40	101.15	119.36	335.91	3.37
133	160.0	35.0	9,530	60	9,470	109.85	136.00	160.48	406.33	4.29
134	160.1	35.1	20,581	...	20,581	238.74	136.08	160.57	535.39	2.60
135	159.9	34.1	7,656	48	7,608	88.25	103.94	122.65	314.84	4.13
136	159.9	35.1	11,374	410	10,964	127.18	135.91	160.37	423.46	3.86
137	116.6	29.0	2,422	...	2,422	28.10	79.29	93.56	200.95	8.29
139	158.6	35.1	13,881	753	13,128	152.28	139.57	164.64	456.49	3.47
141	37.3	2.7	2,416	280	2,136	24.78	32.82	38.73	96.33	4.50
142	159.9	35.1	54,755	...	54,755	635.16	140.71	160.04	935.91	1.70
143	152.9	33.1	15,358	...	15,358	178.15	129.97	153.36	461.48	3.00
144	137.9	30.6	22,824	...	22,824	264.76	124.11	146.45	535.32	2.34
Tot'l	3,137.1	686.7	309,445	6,481	302,964	3,514.36	2,379.16	2,801.34	8,694.86	2.86

Average cost (total) $3.29, based on 109 and 9 per cent burden on direct labor and 15 per cent administration and sales.

Table V

Detailed Cost of Miscellaneous Castings

Weight casting	Hours molders	Hours helpers	Hours core-maker	Cost metal	Labor	Overhead	Factory cost	Adm.	Total cost	Ave. cost 100 pounds
2	0.2	0.0	0.0	0.02	0.14	0.15	0.31	0.03	0.34	17.00
19	0.8	0.0	0.0	0.22	0.40	0.42	1.04	0.10	1.14	6.00
35	0.6	0.6	0.1	0.41	0.56	0.59	1.56	0.16	1.72	4.91
54	0.8	0.8	0.1	0.63	0.73	0.77	2.13	0.21	2.34	4.33
80	1.7	1.7	0.0	0.94	1.53	1.62	4.09	0.41	4.50	5.62
100	1.5	1.5	0.2	1.17	1.38	1.46	4.01	0.40	4.41	4.41
130	2.2	2.2	0.5	1.52	2.03	2.26	5.91	0.59	6.50	5.00
144	1.7	1.7	0.9	1.68	1.75	1.85	5.28	0.53	5.81	4.03
170	1.2	1.2	0.2	1.99	1.17	1.24	4.40	0.44	4.84	2.84
235	3.9	3.9	0.5	2.75	3.77	4.00	10.52	1.05	11.57	4.92
310	1.3	1.3	0.6	3.63	1.56	1.65	6.84	0.68	7.52	2.42
320	4.3	4.3	1.8	3.74	4.73	5.01	13.84	1.35	14.83	4.63
370	3.0	3.0	2.3	4.33	3.90	4.13	12.36	1.24	13.60	3.67
400	4.2	4.2	2.7	4.68	5.19	5.50	15.37	1.54	16.91	4.22
550	8.5	8.5	5.3	6.44	10.68	11.32	28.44	2.84	31.28	5.68
560	2.8	2.8	0.0	6.55	2.52	2.67	11.74	1.17	12.91	2.30
660	3.3	3.3	1.2	7.72	3.53	3.74	14.99	1.50	16.49	2.49

on each casting. It will be noticed in Table V that as the weight of the casting increases, the average cost per 100 pounds decreases, with the exception of the 550-pound casting. This is a pipe casting with a curve about the middle and required a large core, taking the coremaker 5.3 hours to make. The result was, this casting cost us $5.68 per 100 pounds. Great care must be exercised in figuring the cost of production on miscellaneous castings of different size and weight, and those requiring more or less intricate core work. Otherwise, selling prices will be inaccurate causing serious financial losses.

Tests of Cast Iron Show Variations

In a paper on methods of testing cast iron read before the Coventry branch of the Institute of British Foundrymen recently by John Shaw, foundry manager, Brightside Foundry & Engineering Co., Sheffield, the necessity for using test bars which correspond in size to the metal section of the castings they are supposed to represent was emphasized.

Mr. Shaw represents the Institute of British Foundrymen on the international committee which is now investigating methods of testing cast iron. Mr. Shaw pointed out that most of the data on the strength of cast iron, on which specifications for castings are based in English speaking countries, were compiled by Sir William Fairbairn and Hodgkinson between 1827 and 1837. These investigators found that the average cast iron produced at that time had a tensile strength of around 20,000 pounds per square inch. They suggested a factor of safety of six or a working stress of 3340 pounds per square inch. These figures have been carried down to the present day.

In order to show the relationship between strength of cast iron and the metal section, Mr. Shaw gave results of tensile tests on various bars. These tests indicate that a ⅞-inch diameter bar turned down to 0.564-inch diameter possessed a tensile strength of 29,200 pounds per square inch, whereas a 1.2-inch diameter bar reduced to 0.798-inch diameter for testing yielded 27,000 pounds per square inch and a 2.2-inch diameter bar turned town to 1.785 inches gave only 21,500 pounds per square inch tensile strength. The accompanying diagram based on a series of tests indicates the variations in the strength of cast iron according to the diameter of the test bar.

Mr. Shaw also discussed the effect of combined carbon on the strength of cast iron and pointed out that the greatest strength of any given iron is obtained with combined carbon between 0.7 and 0.9 per cent.

Mr. Shaw pointed out that the trend of British opinion is in favor of transverse tests rather than tensile tests owing partly to the belief that few testing machines give a straight pull. "Another grave objection to the tensile strength test," he said, "lies in the fact that it is a test of the structure of the iron rather than its quality. I have no hesitation in saying that I can obtain 24,600 pounds per square inch tensile strength off almost any class of iron if the combined carbon is in the neighborhood of 1 per cent, but that the corresponding deflection and transverse tests show up the quality of the metal as well."

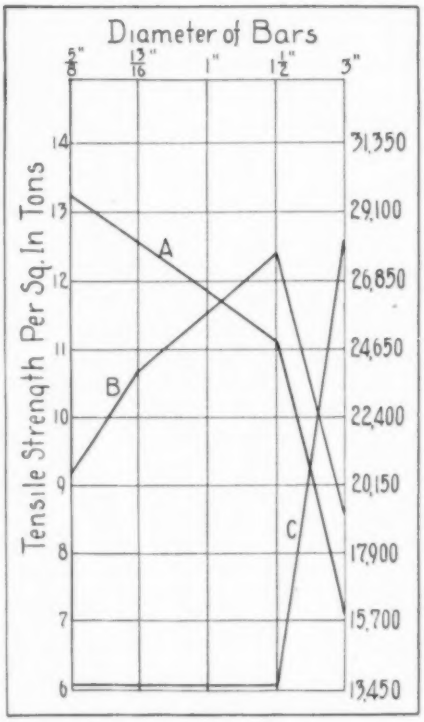

DIAGRAM SHOWING VARIATION IN STRENGTH OF IRON ACCORDING TO SIZE OF TEST BAR

A—Iron Suitable for Strong Thin Castings. B—Iron Suitable for Casting 1½ Inches Thick. C—Strong Iron Suitable for Castings 3½ Inches Thick

Chain Block Employed To Raise the Doors

Question: In a recent issue of THE FOUNDRY we noted an illustration showing the charging floor of a prominent eastern foundry. The caption stated a chain block was employed every morning to pull up the bottom doors. We shall appreciate further details on how the device is operated.

Answer: The chain block is suspended from a hook attached to one of the roof beams directly above the charging door. A short eye bolt is fastened permanently in each half bottom door and furnishes a ready means for hooking the lower end of a long light chain whose upper end embraces the hook on the chain block. Assuming that the cupola has been chipped and daubed the cupola attendant on the stage lowers the free end of the long chain through the charging door. The attendant on the ground floor inserts the hook in the eye bolt, the man on the charging floor pulls up on the hoist until the half door is jammed tightly against the bottom of the cupola. The man on the ground floor wedges an upright steel bar under the center of the half door and then disengages the chain hook and transfers it to the eye bolt in the second half door. This is pulled up in a similar manner and propped in place. When the man descends into the cupola to ram the sand bottom, he releases the chain from the eye bolt and when he emerges later he pulls the chain out of the cupola and loops it to one side of the cupola over a hook provided for the purpose.

The Combustion Utilities Corp., New York, has acquired the Surface Combustion Co. through Henry L. Doherty & Co. At present the merging companies will maintain their own identities.

ALLOY ADDITIONS INCREASE STEEL COST

*By J. M. Quinn**

The addition of the following alloying metals to the steel increases the cost of producing one pound or one net ton by the amount shown. The tabular estimate given is based on ferroalloy prices quoted in the trade papers during January, 1924. An addition of 5 per cent is made to the cost of the alloys to cover freight and handling and large quantity prices are used.

The Addition of Each	When Using Alloy at	Cents Per Pound Ferro Alloy	Cents Per Pound Pure Unit	With Allowance for Loss of	Increases the Cost of Metal: Dollars Per Pound	Increases the Cost of Metal: Dollars Per Net Ton
ALLOYS WITH COPPER						
.05% Copper	99%	0.16	0.16	0%	0.00008	0.160
.10% Copper	99%	0.16	0.16	0%	0.00016	0.320
ALLOYS WITH CHROMIUM						
CARBON						
.05% Chromium, 5.0%	70%	0.088	0.126	10%	0.00007	0.139
.10% Chromium, 5.0%	70%	0.088	0.126	10%	0.00014	0.277
1.00% Chromium, 5.0%	70%	0.088	0.126	10%	0.00139	2.772
.05% Chromium, 1.5%	70%	0.221	0.315	10%	0.00018	0.347
.10% Chromium, 1.5%	70%	0.221	0.315	10%	0.00035	0.693
1.00% Chromium, 1.5%	70%	0.221	0.315	10%	0.00347	6.930
ALLOYS WITH MANGANESE						
.05% Manganese	80%	0.052	0.065	10%	0.00004	0.072
.10% Manganese	80%	0.052	0.065	10%	0.00007	0.143
1.00% Manganese	80%	0.052	0.065	10%	0.00072	1.430

* Formerly superintendent of electric furnaces, U. S. High Speed Steel & Tool Corp., Troy, N. Y.

(*Concluded on Data Sheet No.* 522)

ALLOY ADDITIONS INCREASE STEEL COST

(*Concluded from Data Sheet No.* 521)

The Addition of Each	When Using Alloy at	Cents Per Pound Ferro Alloy	Cents Per Pound Pure Unit	With Allowance for Loss of	Increases the Cost of Metal: Dollars Per Pound	Increases the Cost of Metal: Dollars Per Net Ton
ALLOYS WITH MOLYBDENUM						
.05% Molybdenum	60%	1.57	2.62	0%	0.00131	2.620
.10% Molybdenum	60%	1.57	2.62	0%	0.00262	5.240
1.00% Molybdenum	60%	1.57	2.62	0%	0.02620	52.400
ALLOYS WITH NICKEL						
.05% Nickel	99%	0.42	0.42	0%	0.00021	0.042
.10% Nickel	99%	0.42	0.42	0%	0.00042	0.084
1.00% Nickel	99%	0.42	0.42	0%	0.00420	0.840
ALLOYS WITH SILICON						
.05% Silicon	50%	0.035	0.070	10%	0.00004	0.077
.10% Silicon	50%	0.035	0.070	10%	0.00008	0.154
1.00% Silicon	50%	0.035	0.070	10%	0.00077	1.540
.05% Silicon	75%	0.070	0.093	10%	0.00005	0.102
.10% Silicon	75%	0.070	0.093	10%	0.00010	0.205
1.00% Silicon	75%	0.070	0.093	10%	0.00102	2.046
ALLOYS WITH TUNGSTEN						
.05% Tungsten	80%	0.76	0.95	0%	0.00046	0.950
.10% Tungsten	80%	0.76	0.95	0%	0.00095	1.900
1.00% Tungsten	80%	0.76	0.95	0%	0.00950	19.000
ALLOYS WITH URANIUM						
.05% Uranium	35%	1.84	5.25	30%	0.00314	6.825
.10% Uranium	35%	1.84	5.25	30%	0.00682	13.650
ALLOYS WITH VANADIUM						
.05% Vanadium	40%	1.68	4.20	10%	0.00230	4.600
.10% Vanadium	40%	1.68	4.20	10%	0.00460	9.200
1.00% Vanadium	40%	1.68	4.20	10%	0.04600	92.000

THE FOUNDRY DATA SHEET, APRIL 15, 1924
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

OSBORN

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FOR EVERY PURPOSE
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M. R. ATWATER, VICE PRESIDENT.
E. S. CARMAN, SEC'Y AND CHIEF ENGINEER.

CLEVELAND
May 26 1923

The Foundry
Penton Building
Cleveland Ohio

Attention Mr J D Pease

Gentlemen

It would seem very strange to us if anyone should question the predominence of The Foundry in its field.

As far back as I know anything about we have always considered The Foundry as the back-bone, or main-stay, of our Moulding Machine advertising.

And of course this attitude of ours has been based altogether on the fact that advertising in Foundry pays.

Very truly yours

THE OSBORN MANUFACTURING COMPANY

Donald Payne

Donald Payne
Advertising Manager

DP S

Picking Competent Molders

Exacting Methods for Determining Applicant's Fitness To Fulfill Position Recognized as Desirable—Trade Test Method of Interviewing Prospective Employes Successful in Choosing Men for Foundry Work

BY RUSSELL J. WALDO

MODERN business methods in their demand for lower production costs have commanded that employes be selected with accuracy so that efficient workers may be added to the personnel. The incomplete and disorganized haphazard process formerly employed in hiring workers has proved costly. Because the system is incomplete and aimless in its procedure, it is probably the most expensive method that can be used in the industry. If the most efficient man is to be hired for any certain place, it is necessary that some method of selection be introduced that will make the process as accurate as possible. Sufficient investigation must be carried on to make the process finally adopted as nearly error proof as possible.

Regardless of how familiar the interviewing clerk may be with the job for which he is hiring men, in the rush for time any one may overlook some vital point in the qualifications of the applicant. Since methods are lacking for hiring men each day for scores of different tasks, the interviewing clerk must be provided with a reminder of some sort to assist him in covering the proper amount of ground.

During one of the worst labor shortages this country ever has faced, the writer, then assigned to the position of assistant employment manager, felt the need of some method for selecting with a greater degree of accuracy the employes who were to be assigned to the foundry department and in this way to secure the most efficient men for the place. The writer felt that incompetent hiring and placing of workers resulted from the simplicity with which the applicant could answer enough questions to get by the interviewer and that a method of checking the applicant was needed which would make the prospective employe prove in an explanatory response some of the fundamentals of the department in which he was to work.

Such a method is the special question and picture test illustrated in this discussion. The trade test method of selecting employes, has been misrepresented, perhaps, because the trade tests and employes tests have been of such a nature that they could be handled only by college graduates. The methods outlined are well organized tests whereby, by adequate questioning through specially developed questions, some incorporated with the picture tests, the applicant may prove to the interviewer that he is familiar with the methods of molding and the machines of the trade. The picture test, which is a

Table I

Key to Molders Tools

1 Double head chaplet.
2 Gaggers.
3 Riddle.
4 Casting brush.
5 Rammers.
6 Finishing trowel.
7 Heart trowel.
8 Hub tool.
9 Oval spoon slick.
10 Double bead slick.
11 Leaf and taper slick.
12 Heeled slick.
13 Gate leaf and spoon
14 Sprue pick.
15 Draw hooks.
16 Swab.
17 Draw screw.
18 Draw hook and mallet.
19 Hub lifter.
20 Box.

FIG. 1—TOOLS AND OTHER APPLIANCES USED BY MOLDERS

Table II

Key to Squeezing Machine Parts

Part No.			
1.	Guide rod.	13.	Blow valve.
2.	Lower spring seat.	14.	Blow valve hose.
3.	Set screw in adjustment block.	15.	Hose to knee valve.
4.	Adjustment block for spring seat.	16.	Cylinder base.
5.	Hose coupling.	17.	Trunnion shaft.
6.	Adjustable strain bar stop.	18.	Trunnion.
7.	Oil plug.	19.	Hand lever stud.
8.	Knee pad.	20.	Valve sand guard.
9.	Left hand strain bar.	21.	Pop throttle valve body.
10.	Left hand yoke stop.	22.	Bracket for knee pad.
11.	Clamping screw.	23.	Upper spring seat.
12.	Right hand yoke stop.	24.	Stop bolt for strain bar.
		25.	Counter balance spring.

part of the trade test, should not be used loosely. The test should be given with care so that the man being interviewed may have the opportunity to prove as accurately as possible his understanding of the task for which he is applying.

Many will inquire as to the nature of the picture test. It is an actual photograph of the machine to be used in the position the applicant seeks. A list of parts which are indicated on the applicant's copy, is used by the interviewer in questioning the applicant. The photograph is placed before the applicant and he is asked to name certain levers already indicated on the picture and to tell their function. The parts indicated are used in his daily work and he must be familiar with them if he is to fill the position. The test is practical since it asks the man to name the parts which he must use in operating the machine.

This type of test is applicable to the foreman and every other class of employe. It may be used by foreman, clerks, employment interviewers and other department head.

The operation of this picture test is interesting. First, the photograph of the machine is checked and the parts which the operator must know are indicated by numbers. The list of parts is arranged for the interviewer and the items numbered to correspond to the numbers on the picture. Care must be taken that the parts indicated are used by an operator in the ordinary work. An illustration of a squeezing machine is shown in Fig. 2 and the key list for the interviewer is given in Table II.

The applicant may be asked the function of a certain numbered lever or part, or he may be asked to name part number 20, etc. The illustrations may be taken from trade magazines, catalogs or other literature. Questions may be worked out with the aid of the foreman or manufacturer. It is advisable for the interviewer to have the questions and answers carefully prepared. In this way questions always may be ready which will require thought on the part of the applicant. It is desirable for employes to think clearly, and asking for definitions is a good way to determine the capacity for thought.

Several typical questions used in connection with the machine shown in Fig. 3, are as follows:

Q. What determines if there is sufficient adjustment in the weight counterbalance to assure its effectiveness?

A. The yoke should come up easily against the top bolt and cushion on the spring when swung back.

Q. How is adjustment obtained?

A. Loosen set screws and raise or lower the block to suit.

Q. How many pounds are required for squeezing pressure?

A. A pressure of 20 to 30 pounds.

Q. What is understood when the pattern draws too rapidly?

A. The oil cylinder around the draw cylinder needs filling.

Q. How often should the machine be thoroughly cleaned?

A. Once a month.

Q. How many pounds pressure is required to squeeze a mold and what controls the amount needed?

A. Sixty to eighty pounds according to the quality of the sand and the nature of the work.

Q. What provision is made for keeping the pattern warm?

A. A gas stool plate is provided.

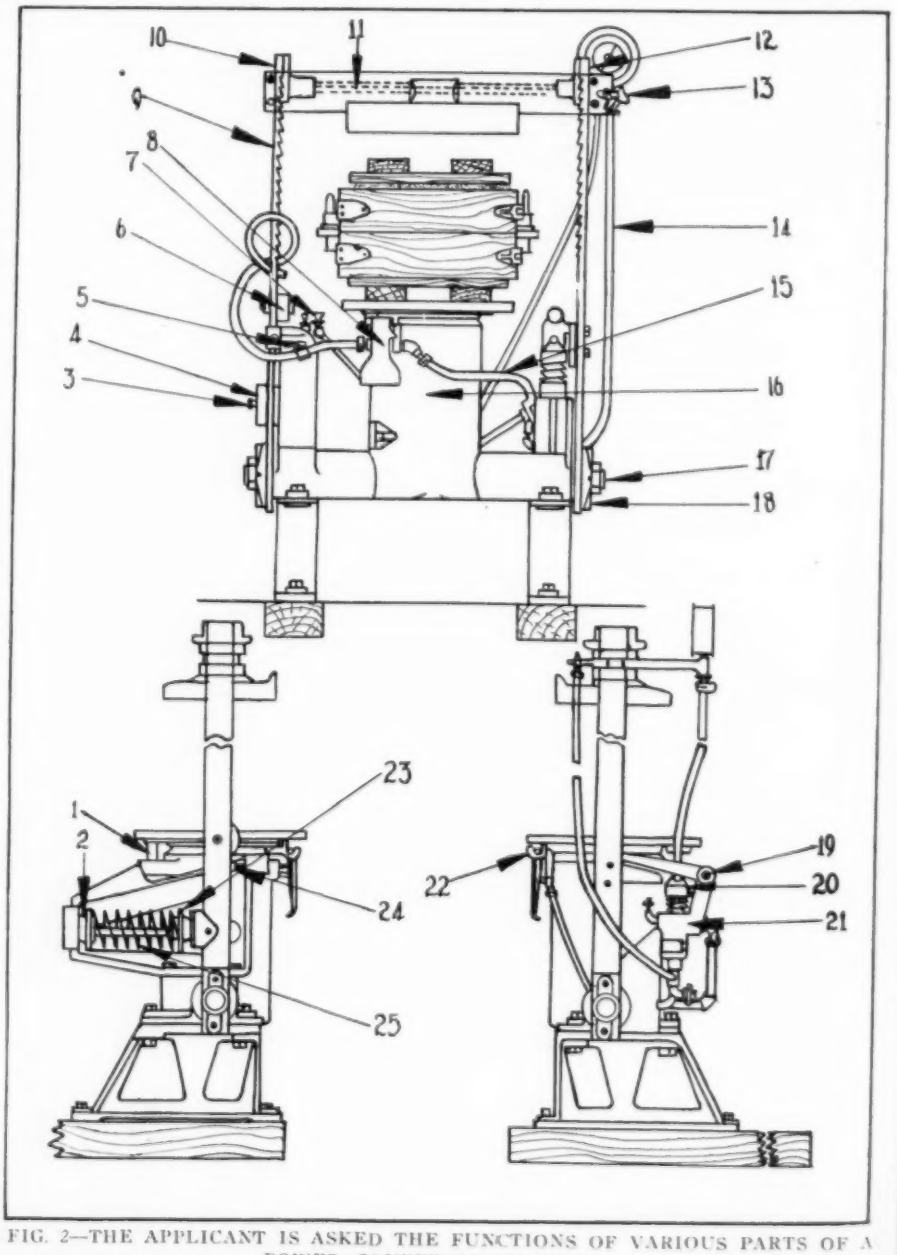


FIG. 2—THE APPLICANT IS ASKED THE FUNCTIONS OF VARIOUS PARTS OF A POWER SQUEEZING MACHINE

FIG. 3—NAMING THE PARTS OF A TUMBLER CONSTITUTES ANOTHER TEST

A different type of picture is shown in Fig. 3. Here 22 parts of a tumbler are shown and the list of parts is given in Table III. The applicant is asked to name the parts shown on the sheet.

Another kind of picture test is shown in Fig. 1. In this test 20 tools used and known by the skilled molder are shown. The list of parts which is retained by the interviewer is shown in Table I.

A satisfactory method of checking up the applicants ability to read accurately is shown in Table IV. A portion of the catalog for a cupola is shown and the applicant is asked to read and observe carefully what is found in the text. The applicant then is asked the questions given in Table V, which gives an easy check on his memory. This test shows not only the applicants ability to read and remember the details of the machine, but also shows to a large extent his interest in the device.

Some questions asked by the writer while working for a large corporation should be of interest. However, these are only typical and scores of others of equal value could be added.

Q. For what are rammers used?
A. For packing sand around patterns.

Q. What is meant by a mold buckling and what causes it?
A. Swelling of the mold caused by the formation of steam.

Q. What part of the mold is the cope?
A. The upper part.

Q. What is meant by the drag?
A. The lower part of the mold.

Q. What is a bod?
A. A ball of clay for closing up the tap hole.

Q. What causes gas to pass out through the iron in the mold?
A. The mold is rammed too hard.

Q. What is the effect of water accumulating under liquid iron?
A. Will raise steam and blow up the mold.

Q. Is there any danger in removing castings from the sand in event the casting remains red hot for two or three hours?
A. Yes, it makes them weak.

When the applicant realizes that the interviewer has the correct answers to the questions, he will take care to make his replies as nearly accurate as he can make them. The trade test method of interviewing applicants has proved successful. It is one which will render the same verdict upon a stranger or a friend and therefore is desirable as a practical means of selecting experienced men.

Table III

Key to Tumbler Parts

Part No.

1. Head without gear bosses.
2. Liner plate.
3. Head with gear bosses.
4. Trunnion.
5. Trunnion journal box cover.
6. Trunnion bearing.
7. Oil ring.
8. Trunnion journal box.
9. Standard.
10. Gear.
11. Pinion.
12. Dust box.
13. Felt washer for dust box.
14. Dust box washer.
15. Dust box door.
16. Dust collar.
17. Safety collar.
18. Belt shifter bracket.
19. Belt shifter.
20. Babbitted shell.
21. Shaft bearing with plain cap.
22. Shaft bearing with gear guard cap

Plan New Steel Foundry

The Fairfax Iron & Steel Co., Kansas City, Mo., has completed plans for a new iron and steel plant. The plant will be 600 to 700 feet long and 160 feet wide and will include steel, gray iron and malleable casting foundries. The company also will make frogs and switches.

A new foundry and machine shop on Willow Street, Reading, Pa., recently has been completed for the Reading Hardware Co. is accordance with drawings and specifications prepared by the Ballinger Co., architects and engineers, Philadelphia.

Table IV

Cupola Reading Test

The shell is of steel plate, that portion of it which is designed to support and enclose the charge being made extra heavy. This heavy construction increases the first cost but is found much more economical in the end, lessening the risk and the amount of repairs constantly needed on a lighter constructed cupola.

The joints of the stack open downward on the outside. This is a feature first introduced by this company and has the advantage of shedding water and keeping it out of the joints, preventing rust to the stack and damages to the lining from this cause.

There are two rows of tuyeres. They are flaring in shape and admit the blast through a small area in the shell which is expanded into a large horizontal opening inside the cupola. The air is thus permitted to reach the fuel through an area nearly double that through which it enters its tuyeres, admitting the same volume but softening its force.

Tuyeres are independent of each other; of such a shape that they are readily held in the lining and will outlast any other tuyere made.

The lower tuyeres form an annular air inlet, distributing the blast continuously around the entire circumference. The upper tuyeres are of similar construction to the lower and are intended to supply sufficient air to utilize to the fullest extent escaping fuel gas.

Each cupola has an automatic safety tuyere so placed that when iron rises too high it will run through the safety down a spout thereby warning the tender.

Table V

Cupola Memory Test

KEY TO CHECKING LETTERS

A The sentence is in the text.
B The sentence is not in the text.
C The phrase is in the text.
D The phrase is not in the text.
E The thought is in the text.
F The thought is not in the text.

A Tuyeres are independent of each other.
B This arrangement affords a practical means of adjusting the tuyeres to suit the lining.
B For smaller heats they may be closed by independent tuyere dampers.
A The lower tuyeres form an annular inlet.
A Each cupola has a safety tuyere.
D Varying heights.
C Entire circumference.
D Softening its force.
D Machined air tight.
C Escaping fuel gas.
D A blast gage.
E Blast is distributed continuously around the entire circumference.
E Joints opening downward prevents rust.
F Slag spout does not require lining.
E The portion of the shell enclosing the charge is extra heavy.
F The tuyere gates are of great value in regulating the speed of melting.

How and Why in Brass Founding

By Charles Vickers

Making Brass Bushings

We are sending for your inspection a piece of a brass bushing and trust you will be able to advise us how it is possible to obtain such a smooth finish on the outside. Possibly it is largely due to the kind of sand used, but we also think the castings may have been dipped in acids, or thrown into water while hot, when taken from the molds.

For a casting of the size forwarded use a molding sand of a grade similar to No. 1 Albany. To get the color it will be necessary to use all new metals, or at least 50 per cent new metal with 50 per cent ingot. Miscellaneous scrap brass is too uncertain in composition to be a safe material to use. Let some one run it down, remove the injurious impurities, and bring it to ingot of specified composition. In other words buy ingot and add half its weight of new metal of the same formula. The bushings have not been dipped in acid, but may have been dipped or blown out in water as this practice produces a nice appearing casting. If the metal is poured from crucibles the dirt or dross which has made the holes in the sample casting can be avoided by getting the metal hot to allow a little extra time to be taken when skimming. After most of the charcoal and scoria have been skimmed off, scrape the inside of the crucible well to dislodge and bring up adhering scoria, then skim again, and make the sprues and gates so the heads can be kept filled with metal all the time. If the metal is poured from ladles, it may be necessary to use skimming gates to get clean castings.

Chilled Bronze Gears

We are interested in securing information regarding the casting of chilled bronze gears, and will appreciate your advice on this subject.

Both aluminum bronze and phosphor bronze gears and gear blanks are made in chill molds and aluminum bronze gears are die cast. It is a question whether phosphor bronze is improved by casting in chills that embrace only the periphery and one side of the gear, while the remainder is green sand. For this reason there is now a reversion to the older method of casting entirely in sand, namely part molding and part cores. Before taking up the manufacture of gears it would be advisable to go into the matter thoroughly.

Cast iron chills are used in some cases for making gear blanks of phosphor bronze, and carbon chills also have been used. At present there is a decided tendency to cast the gears entire with teeth, which complicates the situation for chills. Aluminum bronze gears also are cast in part chill molds, made of cast iron, as well as entirely in chill molds or dies. The latter castings are die castings and as such are superior to castings made in sand but the equipment demands a considerable investment. The molds are poured much the same as all molds made in foundries. After machines and equipment have been secured, and the skill necessary to operate them acquired, there commences a never-ending battle for prices that will permit a small profit on the investment.

Making Bronze Bearings

We have on order a number of bronze engine bearings that will weigh about 40 pounds each, and as this is new work for us and likely to lead to more we would like to give the customer an alloy he would find satisfactory for the purpose. It seems that in the past he has experienced considerable difficulty owing to the bearings wearing unevenly and heating.

It is possible the bearings received heretofore by the customer have been made of an alloy such as copper 88 per cent; tin 10 per cent, and zinc 2 per cent, or some similar alloy. In this case if the bearings were not perfectly fitted to the shafts they would heat up. Even if perfectly fitted the bearings also will heat and even seize if the lubrication is not as near perfect as it is possible to make it. Bearings of such hard metals do not conform to the shafts they hold. If the metal is made from scrap, and it usually is, it will contain iron as nodules and this will score and tear the steel shaft. It is better to use a softer metal for such purpose, one that will flow to some extent and so conform to the inequalities of the shaft. This is obtained with leaded alloys and one that would be satisfactory is made as follows:

BEARING ALLOY

	Per cent
Copper	72.00
Lead	18.00
Tin	8.00
Zinc	2.00

Have Analysis Made

We desire to learn the composition of brass pipe from ½ to 1-inch diameter. We are melting such material and the castings come "seamy" or "cold shut" which gives rise to the suspicion the brass may be very high in zinc, though there is a sharp difference of opinion as to this. Also can you give us a cheap mixture for ball cock seats, and how often should it be necessary to rebrick a furnace used every other day?

Seamless brass tubing varies in composition from sixty per cent copper, forty per cent zinc, to eighty per cent copper, twenty per cent zinc. If the tubing in question is of the former composition, it will not make good yellow brass castings without the addition of copper, unless it is fluxed with aluminum. To be certain about the formula, an analysis must be made.

The length of time a furnace lining will last depends upon the quality of the brick that is used, the character of the fuel and the manner in which the furnace is operated. Its life will be greatly shortened by spalling if water is dashed into it at the close of the day. This frequently is done to harden the clinker and render it easy to punch down the bottom. A good lining ought to last several months. It is no economy to work a furnace after the lining has burnt to a barrel shape, for, not only is fuel wasted because of the greater space around the crucible, but melting is retarded. The crucible may easily "hang" and become cold on the bottom, hot on top, to the detriment of the metal itself.

Casting Monel Metal

At times we are called upon to make castings of monel metal, and have much difficulty handling the alloy, as the castings come spongy, and also break when a thin section surrounds a core. The alloy also is difficult to melt. Please advise if the metal can be cast in common brass-sand molds without being dried. We use monel metal sheet stampings supposed to contain nickel, 60 per cent; manganese, 2 per cent; copper, 35 per cent, and iron 3 per cent.

The spongy condition of the castings may be overcome by the addition of a deoxidizer, and magnesium frequently is used for this purpose. It is added either as a 10 per cent alloy of magnesium with copper, or as a 50-50 alloy of

magnesium and nickel. From 1 to 2 ounces of the latter alloy should be effective and from 0.25 per cent upward of the magnesium copper. The exact amount to add is best determined by trial, as melting conditions determine the amount required.

The alloy is more difficult to melt than brass, because its melting point is higher. A furnace capable of reaching a high temperature quickly is a necessity, and for this purpose an oil or gas fired furnace gives good results. The cores should be soft and friable so they burn and offer little resistance to the contraction of the metal.

Ordinary brass sand rarely gives perfect satisfaction, and better results are obtained when a facing composed of silica sand bonded with clay and molasses water is used. The backing sand should be an open grade. Some founders have success with green sand molds, but frequently the molds are dried, or skin dried.

The composition of the alloy as used for rolling differs somewhat from the casting grade, and better results would be obtained if metal of casting grade be obtained from the makers.

Change the Composition

We have been trying to make castings to a formula furnished us but find they come brittle, while a sample casting also furnished us is tough and strong though supposedly of the same composition. The formula is: copper 63.33 parts; aluminum 3.33 parts; silicon 0.33 parts, and zinc, 33.33 parts.

Why two castings of supposedly similar formula, come one brittle and the other tough and strong is a very easy problem for the chemist to solve, and it can be solved satisfactorily in no other way than by analysis. In the absence of the analyses we will guess at a solution, and the guess is born of practical experience. The composition of the two castings is not the same. One contains more zinc or more aluminum than the other and for this reason is brittle. Judging from the external color of the casting, we will blame excess aluminum and state that if the formula is modified to say; copper 67 per cent; silicon 0.50 per cent; zinc, 30 per cent, and aluminum 2.50 per cent, the castings will be as tough as the sample.

The two alloys should be analysed and compared. The necessary adjustments then can be made with certainty. Any difficulty that may arise concerning the slight change of formula necessary to get strong castings, will cease to be a difficulty when confronted by the evidence as to composition furnished by the strong casting.

Encounter Variables in Heavy Castings

Occasionally we make plunger castings and liners for reciprocating pumps, and cases, covers, impellers and other parts for centrifugal pumps, ranging in weight from 100 to 1500 pounds. Sometimes we have a high percentage of rejections on account of the metal being porous so that it will not hold pressure on test. Sometimes this is simply in spots, at other times it covers large areas of the castings. Often it is not perceptible and at other times shows only in the form of minute pin holes. We have used every precaution to overcome this trouble, and have been successful to some extent as we sometimes run along for quite a while with few rejections, and then again it is necessary for us to make a casting over a number of times before we get one that will withstand the required pressure test. The two alloys principally used are 80-10-10 and 88-10-2, with a small amount of lead to facilitate machining.

Foundry life is filled with experience such as detailed in this question. Sometimes the sun of good fortune is with us, again it is hidden and failures that humble the spirit prevail. When good fortune is long continued we unconsciously assume the attitude that we deserve it because of some superior qualities we possess, and little by little changes born of carelessness creep into our work and build up a rock which in due time smashes our vanity. Then we wonder why it is that sometimes we run along so nicely and then suddenly experience trouble. Its all perfectly natural, and a part of life and it will never change, although it is possible by applied common sense to accumulate information that will enable us to chart a course to the haven of perfect castings, and which, when we fail to reach that haven, will show us, when, where and how we deviated from the proper course, and met with disaster as a consequence.

Every foundryman the writer has met in his consulting experience has been full of earnest assurances that absolutely no change has been made in methods, metal or melting practice, when trouble has arrived right on the heels of good fortune. A moments reflection will show the fallacy of this statement. There must have been some change. Otherwise there could not have been a change in results.

When castings of large size are lost that have previously been made good, we ought to be in a position to check up on the processes involved in making them. This can be done by means of a record of how the castings were made. The molding part of the work would have the grade and condition of the molding sand recorded, the amount of new sand it contained and the amount of moisture therein. Also, if any facing is used, this should be described. The flask and its condition should be also described, and the amount of ramming given the sand, and who did it. The core or cores should be described minutely, attention being given to the kind of binder used, the kind of sand and the proportions of the mixture, also the time of baking and temperature of oven. Every detail about the metal should be recorded; what brands were used, what weights, what deoxidizer, in what furnace was it melted, in what size and make of crucible, if the latter were used; if not all particulars about the furnace, oil and air pressure and so forth.

All this looks like a lot of clerical work, but it is not, for properly printed sheets could be made, and all that would be necessary is to fill in the blank spaces. Also, every defect found on the castings should be rocorded and if this is kept up, after a time, it would be known and recorded just what operations led to good castings, and what to poor or bad castings. Such records are invaluable. After a time the sand would be conditioned properly for the molder, he would be told exactly how to gate the casting after he had rammed the mold. The fact that good castings are made shows this record method to be feasible. All it means is a little trouble at the start, and a good dependable man to make the record.

Watch the Metal

We made some aluminum castings to the following analysis: Aluminum 84 per cent; copper 3 per cent; zinc 13 per cent, using a hardener of 50 per cent aluminum, 50 per cent copper, of which 6 per cent was added to the alloy of aluminum with 13 per cent zinc. Analysis of the castings on two separate occasions showed aluminum 78.32 per cent; copper 14.42 per cent; zinc 8.26 per cent. An investigation showed the melter had placed two squares of 15 per cent phosphor copper in the bottom of the crucibles. Would this have the effect of changing the mixture?

The addition of the phosphor copper would raise the copper content of the aluminum alloy as it would be dissolved, but this fails to account for the small amount of zinc found by analysis. It may be suspected the melter figured 13 per cent of zinc was too much to add to the alloy, and so followed his own inclination. It may be advisable to keep a careful eye on the melter all the time he is doing his work or else get another melter. No difficulty need be anticipated in making the alloy to formula, since all required is to weigh the various metals properly and then melt them together.

Fig 1—General view of plant of Dibert, Bancroft & Ross Co., Ltd., New Orleans. The new building on the left is the steel foundry and the small office building is the metallurgical laboratory

Make Electric Steel in South

New Orleans Company Specializing in Sugar Mill Machinery Installs Acid Electric Furnace To Make Railroad Castings—Metallurgical Control Insures Uniform Quality of Metal Poured

UNTIL recently the scope of industrial activity in the state of Louisiana has been so limited that there has been little incentive for developing foundries and machine shops to the extent found in sections of the country where the manufacture of metal products is more extensive. In 1923 there were 36 foundries in the state, of which 15, or about 42 per cent were in the city of New Orleans. Nine of these 15 plants turn out gray iron castings and in six the product consists of brass and aluminum castings. Recently, however, New Orleans joined the ranks of cities in which electric steel castings are made. It acquired this distinction by virtue of a new steel foundry built by the Dibert, Bancroft & Ross Co., Ltd., which has been engaged in the general foundry and machine shop business for a quarter of a century. The new foundry is interesting, not only because it marks a new line of development in the foundry industry of the South, but also because in its equipment, methods of operation, extent of metallurgical supervision and quality of product it compares favorably with the leading foundries of the largest industrial centers of the North.

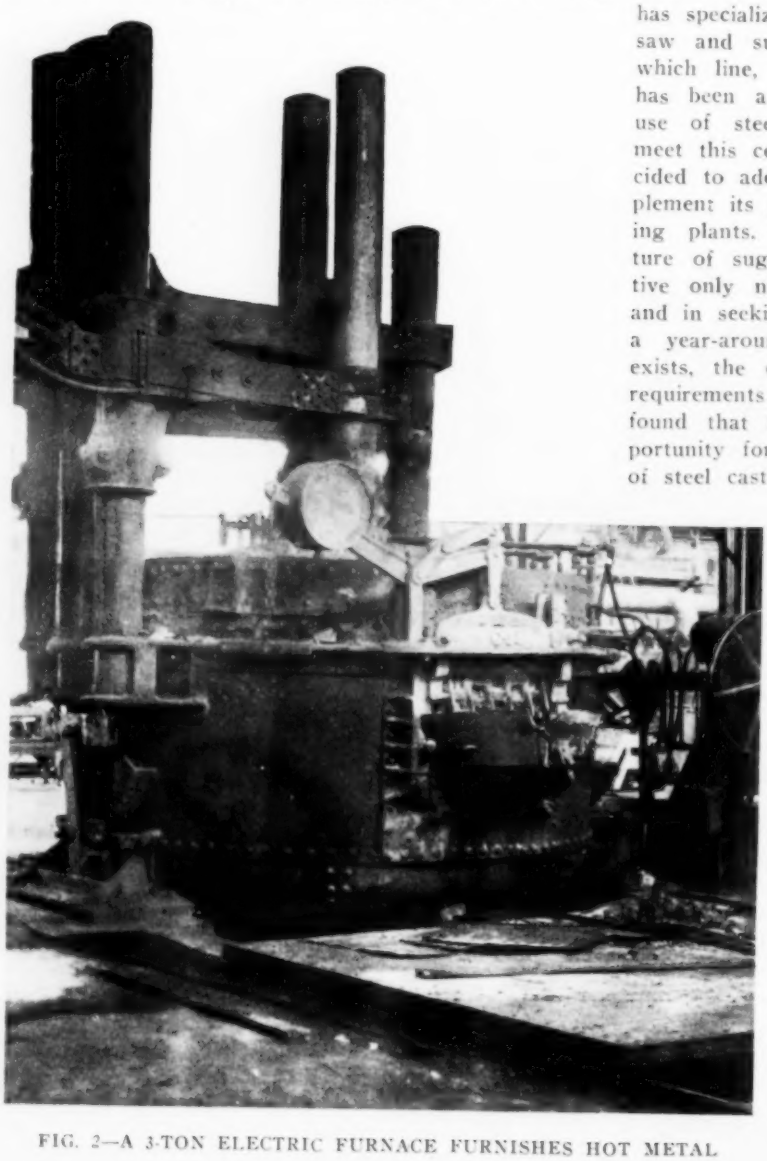


FIG. 2—A 3-TON ELECTRIC FURNACE FURNISHES HOT METAL

The Dibert, Bancroft & Ross Co. has specialized on the manufacture of saw and sugar mill equipment, in which line, as in many others, there has been a gradual increase in the use of steel castings. In order to meet this condition, the company decided to add a steel foundry to supplement its gray iron and brass casting plants. Moreover, the manufacture of sugar mill machinery is active only nine months of the year, and in seeking new markets in which a year-around demand for castings exists, the company investigated the requirements of the railroads and found that their needs offer an opportunity for a fairly steady tonnage of steel castings. As a result of this investigation the new foundry was built and equipped especially for the production of railroad castings. The steel is made in an electric furnace, made by the Pittsburgh Electric Furnace Corp., Pittsburgh. It has an acid lining and hearth, and while its rated capacity is 3 tons, heats as large as 18,000 pounds have been successfully made. Due to the operating and climatic conditions certain departures from usual practice are followed. The roof is made of first grade clay brick instead of the generally accepted silica product. In view

of the conditions, this roof gives good service, the average life being approximately 200 heats of about four tons each. Silica brick are used for the lining, their life approximating 500 heats. Bottom-pour ladles are used exclusively, castings of small size being stacked rather than being poured with shanks. The foundry is spacious and the arrangement of the melting, molding and cleaning equipment is well planned. The building consists of three bays, each 50 feet wide and 250 feet long. One contains the molding floor proper; the middle bay accommodates the core room, the acetylene burning and sprue cutting equipment; and the third bay serves as a floor for either cleaning large work or for molding side floor castings of small size, depending upon the rate of production of the shop.

FIG. 3—A CORNER OF THE FOUNDRY SHOWING A JOLTING MACHINE AT THE RIGHT AND ANOTHER AT THE EXTREME LEFT—RAILROAD CASTINGS ARE AN IMPORTANT PRODUCT OF THIS PLANT

The electric furnace is at one end of the molding floor, with the ladle room directly in front of the melting unit. To the rear of the furnace is the scrap pile, provision being made for a spur track directly under the crane so that all scrap can be handled readily by means of an electric magnet. At the far end of the molding floor is the shake-out pit, and the sand mixer, the latter being made by the National Engineering Co., Chicago. Along one side of the molding floor are three jolt machines, built by the Osborn Mfg. Co., Cleveland.

Molding Floor Classified

The molding floor is arranged in sections, each being devoted to a special class of work. A section is provided for car castings, one is for bolsters and similar work and another is devoted to the higher classes of quality castings, such as locomotive wheel centers, frames, etc. This arrangement aids in keeping check of the pour, and insures that the grade of metal called for will reach its proper destination with little chance of error during the casting period. The cleaning room is equipped with modern machinery consisting of sand blasting equipment, tumbling barrels, various sized swing grinders, stationary grinders, electric and acetylene welding apparatus, etc., shown in Figs. 5 to 8.

All work is handled either by crane or by trucks, the latter proving satisfactory for carrying castings along their route during finishing. The molding bay is served by two 10-ton electric cranes and the center bay by one 5-ton crane equipped with an electric magnet. Each molding machine is equipped with a 1-ton electric hoist to aid in handling flasks during molding. Two drying ovens for molds are provided, one having large enough to take railroad castings of any size. The smaller one is used

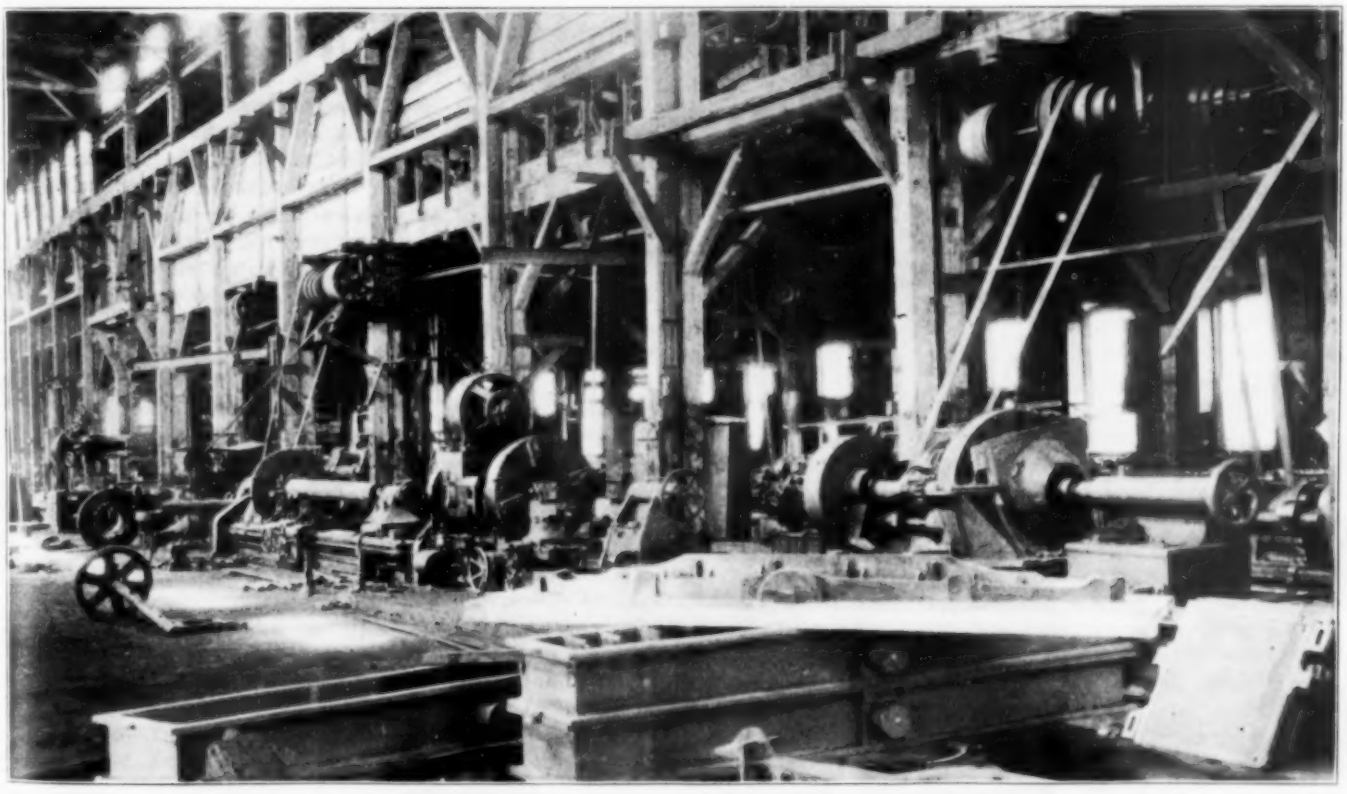


FIG. 4—MUCH OF THE PRODUCT OF THE COMPANY CONSISTS OF SUGAR MILL MACHINERY—AN EXTENSIVE MACHINE SHOP IS MAINTAINED IN ORDER TO FINISH THE CASTINGS FOR THIS INDUSTRY AND FOR RAILROADS

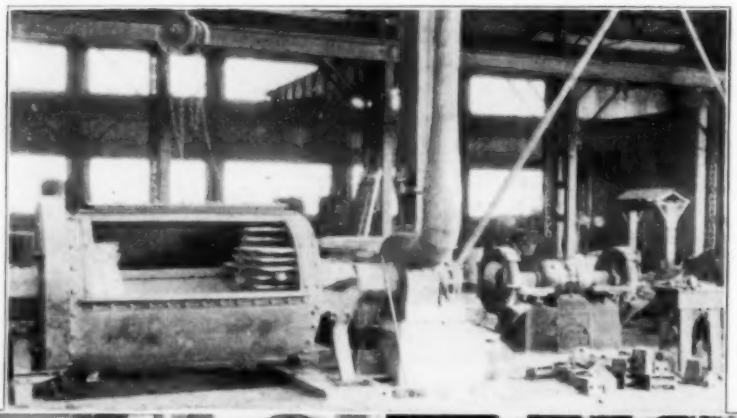
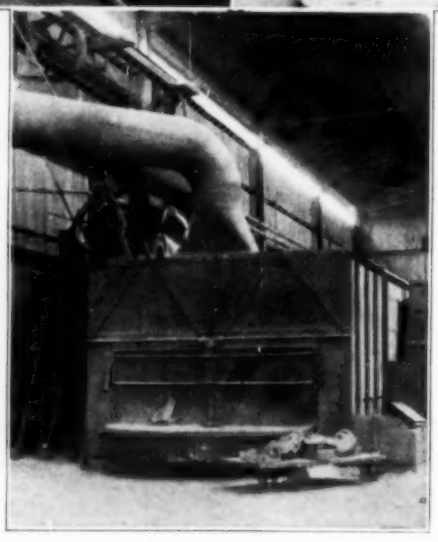


FIG. 5—(RIGHT)—A VIEW OF THE CLEANING DEPARTMENT SHOWING A TUMBLER AND GRINDING STAND FIG. 6 (BELOW)—SWING GRINDERS ARE USED FOR TRIMMING HEAVY STEEL CASTINGS

FIG. 7—(RIGHT BELOW)—SMALL PORTABLE GRINDERS ARE EMPLOYED FOR TRUING UP LOCOMOTIVE CASTINGS FIG. 8 (CENTER BELOW)—A SAND BLAST UNIT CLEANS CASTINGS OF A WIDE RANGE OF SIZES



for core drying as well as small castings.

Considerable thought has been given to the economical production of steel castings of high quality. The problem required an effective plan of routing work, all details being under the direction of the metallurgical department.

In selecting scrap, only the highest grades of metal are purchased and care is exercised in determining the chemical and physical characteristics. The scrap must be of such size and physical character as to be easily charged and to melt down under the most favorable conditions. Its chemical composition is closely checked in a completely equipped chemical laboratory. After the scrap has been charged the same close chemical control follows throughout the course of the melt.

High Quality Is Sought

Care is taken during melting to obtain perfect conditions, slag control being exercised to the highest degree. A heat never is poured unless the melter is assured of its quality. On heats where there is the slightest doubt, common castings are poured, such metal never being cast into locomotive work. Alloys are added in the furnace and great care is taken to see that the pouring temperatures are right. This results in a freedom from cracks or scabbing in the finished work, the castings having a good appearance due to the careful adjustment of the metal. Aluminum never is used in any form, the company holding to the theory that a good steel requires no "dope." As many castings are machined in the company's own shop, an excellent opportunity is afforded to follow closely the behavior of the metal under the tool, which in the end is one of the best tests for a steel casting.

The performance of the furnace has been most satisfactory. Four heats are easily made in 8 hours, the average power consumption being approximately 565 kilowatt-hours per ton. The time for the actual running of a heat averages from 70 to 90 minutes, depending on the size of the heat. On special heats it has taken two hours and one-half for a 6-ton charge, and three hours and 35 minutes for a 9-ton charge. The average charge, however, is about 7000 to 8000 pounds.

From the furnace the metal is poured into the molds and as soon as the pouring is finished and the steel is set the molds are taken by the crane and shaken out in close proximity to the sand mixer, the flasks being returned to the molder. In this manner the floor is always kept clear, and a good turnover of equipment is assured. After the castings are freed in part from the sand, they are sent hot to the cleaning floor. On their way they pass the sprue cutter and the acetylene burner where the gates and heads are removed. The sprue cutter is able to cut a section up to two inches in thickness.

Cleaning Process Is Thorough

From this station the castings go to the sand blast, except certain classes of castings which go to the tumbling barrel. The tumbler holds approximately 100 center plates or similar castings and is equipped with a suction fan to draw out the dust. The sand blast has two rooms, one for small work, and the other for castings of larger size. From here the castings go to the chippers, then to the swing grinders, and as a final treatment are given a general going over with hand grinders. The work then is annealed and is ready to chip. While this extra cleaning costs a little more a ton of metal it has been found that this extra attention to the appearance of a casting pays large

dividends. The average customer places more faith on the appearance of a casting than on its chemical or physical qualities. That the quality of the work is high is shown by the exceedingly small number of castings returned by customers, this amounting to under 100 pounds per 1000 tons of metal charged into the furnace.

Considerable experimental work is carried on by the metallurgical department covering new types of metal for certain classes of work, bettering the quality of the standard grades of steel and closely checking annealing and heat treating results. Several new steels have been developed for special work and are proving satisfactory under test. One is a metal designed to withstand high pressures while the other is a special gear steel used for driving wheels for heavy sugar mills.

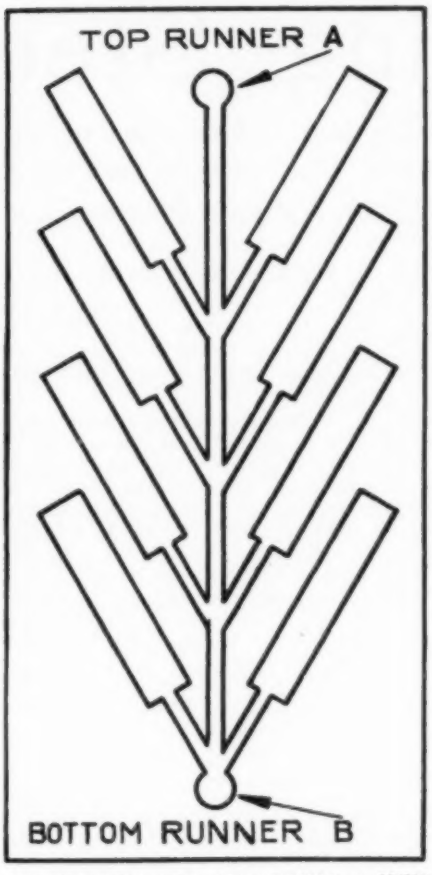
In the one year this new foundry has been operating the output has been increased from nothing to over 300 tons per month, with the possibility of having to care for nearly 600 tons per month during the rush of the sugar mill season and possibilities of growth in tonnage are seen in other directions.

Gating Small Patterns

Question: I should like to have your opinion on whether the method shown at *A* or that shown at *B* in the accompanying sketch, is the better in gating small castings. In one foundry I have noted that the patterns all are gated according to one method and in a second foundry I find they are gated in the opposite manner. What advantage, if any, attaches to either method.

Answer: Under certain circumstances either method may have an advantage over the other, but in the great majority of cases the method simply represents the personal preference of the patternmaker.

Many small brass castings are poured while the mold is in an inclined position and in those cases the direction in which the castings point to the central runner is an important factor. Some flasks are poured from a sprue located at the highest point, while others are poured from a sprue located at the lowest point. In the first case the most advantageous position in which to group the patterns is shown at *A*. The metal runs first to the lowest point of the runner and then gradually backs up and in that manner fills the individual molds gently from the bottom. If the position of the individual patterns was reversed so that they pointed down instead of up a little metal might be deflected from



SUGGESTION FOR ATTACHING A NUMBER OF SMALL MOLDS TO A COMMON SPRUE

the main stream and run into the higher molds. By the time the main stream backed up after filling the lower molds this deflected metal would have solidified and the new metal would not unite with it.

The same idea holds true where the sprue is located at the lowest point in the mold. The individual patterns should be attached to the central runner as shown at *B*. By this arrangement it is apparent that the lowest molds will have to fill before the metal travels any higher in the central runner. If the patterns were pointed in the opposite direction, that is like so many back pockets into which the metal would have to fall on its journey past, some of the molds would not fill properly. In general, it may be stated that the relative position of the patterns is not an important factor where the mold is to be poured in a level position. Of course, there are exceptions to this rule. Where molds are poured on an incline the patterns should be arranged in such a manner that the metal surely will enter the lowest molds first.

H. L. Gilliam, formerly district sales manager at Norfolk, Va., is in charge of the New York office of the Wood Shovel & Tool Co., Piqua, O. The New York office of the company is at 50 Church street.

Gives Data on Aluminum

An interesting paper entitled, The Tensile Properties of Aluminum at High Temperatures was read by Thomas Martin, at a meeting of the British Institute of Metals held in London March 12-13, 1924.

The paper refers to early investigations on the tensile properties of metals in general at high temperatures and how these early methods of procedure have been improved by the advent of the electric furnace, and other modern devices with thermocouples in actual contact with the test pieces for temperature readings, etc.

The high temperature tests were made on the pure aluminum as well as on the commercial metal in the cold worked and annealed condition and the comparison of the results are given by tables, charts and photographs.

The conclusions presented by Mr. Martin are from the tensile tests on these two qualities of aluminum at temperatures ranging from 16 degrees to 640 degrees Cent. The latter is near the melting point of pure aluminum. The conclusions show a rapid decrease in the strength of the metal with a corresponding increase of ductility up to approximately 325 degrees Cent. at which point a marked increase of ductility takes place. This increase is attributed to a sudden advance in the rate of recrystallization. With higher temperature, the *loss* of strength continues at a less rapid rate.

A comparison of the results for cold-worked and fully annealed material shows that up to 200 degrees Cent. the added strength recorded by the cold worked material is well maintained, but at the higher temperatures, the rate of softening is such that only reliable indication of strength is that obtained on the annealed metal. The tests on the commercial metal show that the impurities present tend to make it stronger, but less ductile at all temperatures.

Form Metal Group

The Fresno Metal Trades association, Fresno, Cal., has been organized with membership open to all foundries, machine shops, ironworks and other metalworking industries. G. R. Matthews, Matthews Foundry Co. is president, G. L. Roberts, Pioneer Brass Foundry, vice president and G. J. Doland, United Engine & Machine Co., secretary and treasurer.

The name of Davies & Baird, 29 Brunswick road, Melbourne, Australia, has been changed to Davies, Baird & Robertson. Mr. Robertson has been a partner in the business since 1916, the change now made being a matter of name only.

Maintaining Steel Ladles

Principal Causes of Trouble in the Operation of Bottom Pour Steel Ladles Are Outlined Together with Recommended Remedial Practice Based on the Author's Personal Experience

BY S. R. ROBINSON

STEEL may be melted under ideal conditions and fit to meet any specification at the moment it leaves the spout and yet if the ladle does not function properly the same heat of steel may be a total loss or at best may be responsible for a floor of more or less unsatisfactory castings. A list of the major sources of bottom pour ladle trouble includes the following:

1—Attempting to use a ladle that has not been thoroughly dried and heated.

2—Improper stopper. (a) Nozzle and stopper do not coincide on contact circle. Almost without exception graphite stoppers are perfectly round, but in many instances the fire clay nozzle will be found to be slightly oval and as a result the stopper does not fit closely. A favorite but mistaken method for correcting this feature is to revolve the stopper in the nozzle opening. If a black circle remains on the nozzle it is assumed that the stopper is a perfect fit. It readily is apparent that only slight pressure is required to wear the comparatively soft graphite stopper to a degree that will permit to produce a black circle on the nozzle. This evidence does not necessarily mean that the nozzle is round. A better way to fit the stopper into the nozzle is to rub the stopper down to a bearing. This should be done before the stopper is placed on the rod and before the nozzle is placed in the ladle. A little sharp sand sprinkled around the stopper will facilitate the rubbing action by which the stopper is ground to a fit. Occassionally an opinion is advanced to the effect that the skin of the stopper should not be broken, but according to the writer's experience no outward effect has been noted as a result of fitting the stopper in the foregoing manner. (b) Sometimes the stopper is given too much spring. Instead of being set plumb so that it drops fairly into the nozzle, it is set more or less to one side and strikes one side of the opening before it springs into its seat. A stopper should be set with a slight spring, but this feature often is over done. (c) Nozzle is not set plumb and level in its place in the bottom of the ladle.

3—No provision is made for expansion of the sleeve or stopper rod. This contingency can be taken care of either by backing the nut on top of the rod or by inserting a coiled spring between the nut and the top sleeve section.

4—Cracked sleeves may be caused by not providing sufficient space between the stopper rod and the sleeve or by packing the space too tightly with sand. When the rod becomes expanded by heat it cracks the sleeve.

5—Nozzle bricks sometimes are not sufficiently refractory to withstand the heat of the molten steel in extreme instances the nozzle melts, runs into the opening and shuts off the stream of metal.

6—In a foundry where bottom pour ladles are employed every person is familiar with the saying "the second mold is the hardest." This refers to the ever present danger of shutting off too tightly on the first mold or a delay in opening up over the second mold. When this happens the stopper sticks in the nozzle and usually entails a considerable amount of trouble before it can be lifted over the second mold. The best recommended practice is to open over a large mold so that a sufficient quantity of metal will flow through the nozzle to thoroughly wash all the cold metal from the bottom of the ladle and also thoroughly heat the nozzle . A comparatively long pour also gives the ladle man an opportunity of trying the stopper by shutting the stream off once or twice temporarily before the mold is filled. In this manner he probably will secure a clean shut off. Where only a meidum size mold is available for a start it is advisable to have the second mold quite close to the first and directly in line so that the craneman can spot the ladle over the second mold without loss of time. The craneman should be instructed specifically before the heat is tapped, the order in which the molds are to be poured. Where all the molds are small it has been found advisable to make the first opening over a short ingot mold in close proximity to the first mold. Several hundred pounds may be poured into the ingot mold and the stopper may be raised and lowered several times until the ladleman is satisfied that he has a satisfactory shut off.

7—Sometimes a stopper sticking in the nozzle will cause the loss of an entire heat. This condition may be caused by shutting off too hard over the first mold especially if any delay is experienced in opening up over the second mold. If the ladle is provided with an extra long handle, the ladleman may not be aware of the tremendous force he is exerting on the stopper rod. As a rule a short lever is to be preferred to a long one. If the nozzle and stopper are adjusted and set up properly and if the metal is at a proper pouring temperature a gentle pressure is sufficient to insure a clean shut off. Usually a pricker made from a hammer handle and held with a pair of tongs is all that is required to open a frozen nozzle. The upper end of the handle is inserted in the nozzle and then the ladle is lowered over the edge of a flask or an ingot mold. After the metal starts to flow a reasonable amount is allowed to run through before the stream is shut off. Unless further complications are present or develop later, the remainder of the heat usually may be poured satisfactory.

8—Where the nozzle freezes on account of cold metal it may be opened some times by a wood pricker as referred to in the preceding paragraph. However an application of oxygen will prove a more expeditious method. One end of a suitable piece of hose is attached to the oxygen bottle. The other end is connected to a 6 or 8-foot length of ¼-inch pipe. The outer end of the pipe is bent approximately at a 90-degree angle and inserted in the nozzle. The oxygen is turned on and almost invariably results in burning a clean hole through the frozen metal. In this connection also it is interesting to note that the oxygen flame may be applied toward the removal of the skull immediately after the ladle is dumped. The flame is employed to cut intersecting channels through the skull at right angles thus dividing the skull into four approximately equal parts which may be removed with ease when the ladle has cooled.

Prejudice exists in many steel foundries against the use of bottom pour ladles and even where they are employed, in many instances, their operation is not regarded with confidence. This condition should not exist. The writer frequently has poured six successive heats of converter steel through one nozzle in the same ladle. A new stopper was set before each blow, but the only attention bestowed on the nozzle was to ream it out each time with a flat reamer attached to a long rod.

Local conditions sometimes are responsible for unsatisfactory pouring practice. For example in some shops the ladle man is not under the direction of the melter. In others the ladle man makes up the ladel, but the floor foreman pours the heat . Again, the melter may not be held responsible for the metal after it has been tapped into the ladle, and therefore it is only natural that he should not worry to any noticeable extent if the ladle is not as hot as it should be, if the nozzle leaks or if the ladle is handled so slowly that the metal becomes cold. Probably the majority of melters do not maintain this indifferent attitude, but it is only natural that he should not take as much interest in the proceedings as if he was held responsible for the condition of the metal until it was poured into the molds.

Obviously it is desirable that the ladleman should come under the jurisdiction of the melter. Also that the melter should be held responsible for the proper

care and upkeep of the ladles, stoppers, etc., and for the actual pouring of the metal into the molds. The usual argument advanced in opposition to this program is that the melter considers his presence necessary on the platform during the process of making the bottom after each heat is tapped. However, this argument really has no weight where an efficient first helper is employed.

After trying practically every available lining material the writer has obtained the best results from a brick lining coated with a slurry of common red brickyard clay. A split brick is placed next the shell followed by a 9-inch brick laid the 4½-inch way if the capacity of the ladle will permit that arrangement. If not the brick may be laid the 2½-inch way. A hard burned smooth fire brick is the most suitable for the purpose. A heavy coating of thick red mud laid on the brick for about one third of the distance between the top and the bottom will facilitate the removal of any skull that may form.

Casting Is Made and Gated Like Bath Tub

Question: We are enclosing pencil sketch of a casting we have on order and will appreciate your advice on the best method to adopt in making the mold. We are particularly interested in how to gate and pour it.

Answer: With the exception of the ribs and a slight increase in thickness the casting in nearly all respects resembles a bath tub and therefore it is only reasonable to assume that the methods practiced in a bath tub shop are the most suitable for this particular job.

The style of pattern will depend on the number of castings required. A wood pattern will serve satisfactorily for a long period if handled carefully. In addition to the pattern you will require a follow board and a three-part iron flask. If you only have one casting to make, you might utilize a wood flask by bracing the sides from the walls of the shop or by timbers anchored to stakes driven in the floor.

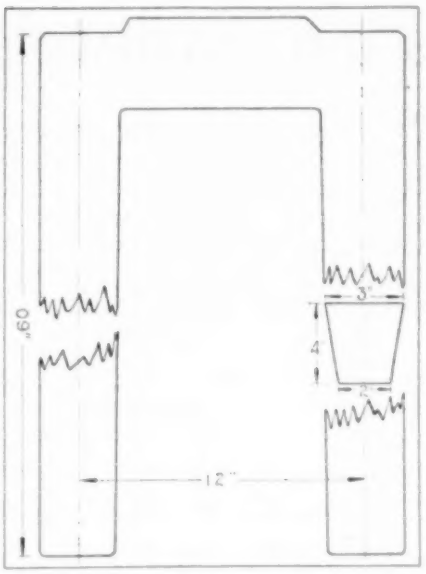


FIG. 2—BLOCK FOR MAKING RUNNER BASIN

However, it is a risky expedient on a job of this kind. If the iron does not run out at the lower joint of the flask, the side walls of the casting surely will swell to an abnormal thickness. An iron flask will retain its own shape and hold the mold in shape if ordinary reasonable precautions are observed in ramming the sand. Also an iron flask may be made smaller than a wood flask and in that manner the amount of sand and time required in ramming it full of sand are cut down. Inside dimensions for a suitable flask follow. Drag 66 x 40 x 4 inches; check 66 x 40 on the bottom and 66 x 30 on top x 22½ inches; cope 66 x 30 x 4 inches. The flasks are reinforced with exterior flanges top and bottom and are drilled for a guide pin at each end, one larger than the other to prevent accidental closing of the mold end for end. The cope and check are handled as a unit and therefore the only guide pins required are those for locating the check on the drag. The guide pins project through holes in both the upper and lower flanges of the drag and extend at least 22½ inches above the drag joint line. A trunnion on each end of the drag is the most convenient device for rolling it over. The check is provided with two handles on each side. The cope is provided with trunnions.

The drag is a plain one-piece casting. The cope also is a one-piece casting with a set of bars spaced on 7-inch centers and with a row of reinforcing chuck bars extending from end to end in the center. The check is made up of four plates bolted through flanges at the corners. The plates are molded in open sand. They are provided with several rows of bolt holes spaced on 8-inch centers for holding the chuck bars and in addition are provided with numerous other small openings to serve as vents.

The pattern is lowered into the follow board which must be a close fit on the sides to prevent the pattern from being rammed out of shape. The pattern is filled with sand and *tramped off* in successive courses. The drag flask is placed, filled with sand and rammed. The sand around the edge of the pattern is butted firmly to form a solid joint. After the drag is vented the bottom board is clamped in place and the drag is rolled over. The straight ribs on the sides and end of the pattern are attached permanently, but the slanting ribs on the ends are attached temporarily each time the pattern is used, by wire nails. The nails are withdrawn as the ramming of the check progresses.

The check is rammed in the usual manner, but no parting is made on the top. The cope is lowered into place and rammed full of sand. It is clamped firmly to the check. In scraping the sand from the top of the cope a thickness of approximately ½-inch is left on the top of the bars. Two strips each about 4 inches wide and about 12 inches apart on the centers are slicked on the sand and the two rows of six ¾-inch holes spaced approximately equal distances apart are punched with a sprue cutter down to the pattern. An additional hole is punched down close to each corner of the pattern to serve as a riser, to relieve the strain on the mold and to drain the iron out of the pouring basin.

The runner basin is made up before the combined check and cope are lifted. A special runner block similar to that shown in the accompanying illustration is placed over the two rows of runners. It is surrounded by a frame which is rammed full of sand. The block is withdrawn, leaving a perfectly clean smooth channel for the iron to enter the mold. The casting will weigh approximately 700 pounds and we assume that it will be poured from a crane ladle at one end of flask.

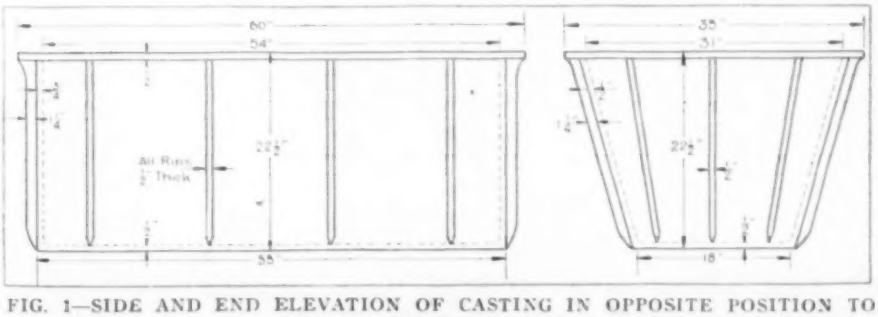
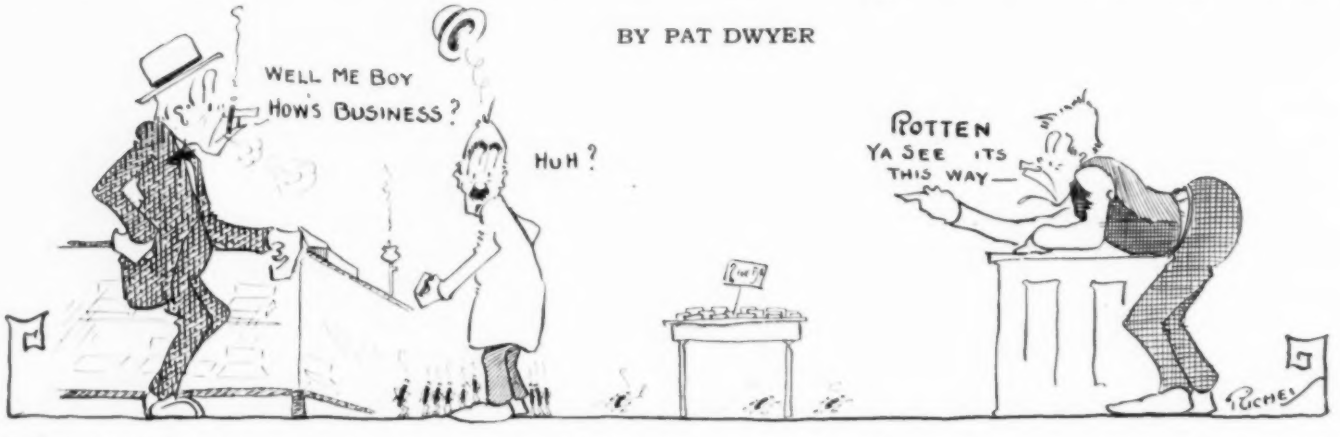


FIG. 1—SIDE AND END ELEVATION OF CASTING IN OPPOSITE POSITION TO THAT IN WHICH IT IS CAST

Bill Airs Views on Sashweight Castings-III

BY PAT DWYER



SPEAKING of high finance and all that kind of thing—I know you were not talking about it—but a man has to start a story somewhere, has he not? Well then, talking of money I was reminded the other night that all the worries incident to making a more or less honest penny are not confined to the captains of industry or that other large class vaguely referred to by the common people as men who are engaged in some kind of intangible business in the city.

About once a week I buy a paper of tobacco in a small neighborhood store presided over by a solemn faced young man. The store is in close proximity to a grammar school and the proprietor sells all the goods usually handled in a store of that character, newspapers, periodicals, toys, candy, chewing gum, tobacco and the hundred and one small pieces of school equipment which the budding young scholar considers indispensable.

On the first few occasions I visited the store, I was impressed favorably by the manner in which I was served. The young man made no effort to strike up a conversation. In fact, he said nothing. I asked for the tobacco. He handed it to me. I placed a dime on the counter and walked out. I don't like these poll parrots who without provocation of any kind insist on telling me it is a fine day, or that it looks like rain or that they see by the papers where a gunman stuck up a bird the night before and knocked out three of his front teeth because he only coughed up $3.41. I am not interested in the state of the weather or in any person's comment on it and the stick up stories have been featured so long and so constantly on the front pages of the newspapers that I no longer even read them.

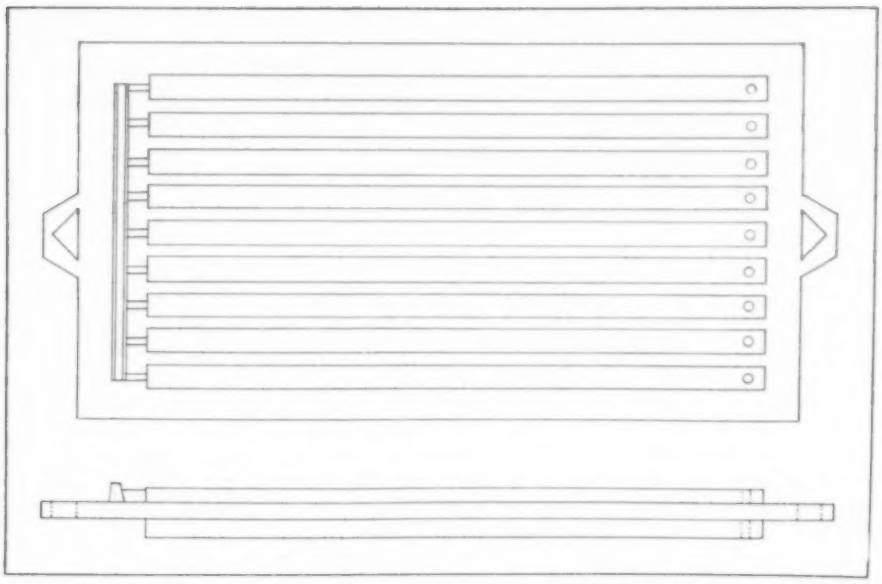
I entered the store one night and found the proprietor serving or attempting to serve several customers at the same time. With the laudable and perfectly justifiable intention of helping both him and myself I reached into the wall case containing the tobacco, selected and removed a package, laid a dime on the showcase and walked out. I have pursued the same policy since, even on occasions when no other customer was present and the arrangement seemed to work out to our mutual satisfaction. Week by week, my respect for the young man increased. He was a lad after my own heart. One of those rare and precious jewels who believe in and act up to the spirit of the golden rule: When you have nothing to say, say it.

In company with Bill I entered the store the other night and as a result I have been compelled reluctantly to revise, in fact to reverse my former favorable opinion. The sphinx came to life and with the exception of big Jim Dalton with whom I roomed and worked in a midwest city at one time many years ago, I never heard such a monolog artist. Bill was directly responsible for the flood. He talks to every person he meets. The necessity of forming an acquaintanceship or getting introduced means nothing to him. He just naturally likes to talk and assumes that every person is willing to tune in on his wave length at any time. Apparently he is equipped with both a broadcasting and receiving set and is willing and ready at any and all times and places to use either one or the other or both.

In the present instance he bought a pocket full of 3 for 10 stogies and having cocked a lighted one at a jaunty upward angle in a corner of his mouth he leaned against the showcase and asked the proprietor how he found business. A totally unwarranted and irrelevant question, I say. What difference did it make to him how the young man found business? Bill never had been in the store before that night, he did not live in the neighborhood and the chances were about 10 to 1 against his entering the store in the future. Despite these factors that would have caused any sensible person to hesitate, he leaned familiarly against the showcase and as one old friend to another said: "Well, me boy and how do you find business?" Just like that. That's Bill all over.

Knowing Bill's propensity for striking up a conversation with every person with whom he comes in contact, tinkers and tailors and candlestick makers, I warned him before we entered the store not to feel offended if his steel failed to strike fire from the flint-faced lad behind the counter. I might have saved my time, my good intentions and my precious breath. Whether or not Bill's question furnished the last straw is a point that probably never will be settled satisfactorily. It will take its place with other classics of a like character: Who struck Billy Patterson, who killed

HE WANTS ACTION FOR HIS MONEY



SPLIT PATTERNS ON OPPOSITE SIDES OF A PATTERN BOARD OR PLATE

Cock Robin; who won the war; and who's who and why. It may be that flint face recognized a kindred spirit or it may be that he craved sympathy. Probably he was full of bottled up words and Bill's kindly inquiry touched off the vent, or it may be that he was naturally loquacious but shy and wanted only a little gentle encouragement to bloom in all his glory. Whatever the reason, he certainly told Bill how he found business.

He told him up and down and sideways, crisscross, catty corner, swing your partner and sashay down the center. Business, take it from him, was rotten, his business, and for two pins—little enough says you—he would sell out and get a job driving a garbage wagon. On the second thought he cheerfully would accept a job as second helper on one of those noble if at times slightly-er- malodorous conveyances.

"You have no idea," says he, "What I am up against in this here joint. I don't mean the grown up folks, although some of them give me the pip. I could give you the names of a few birds around here, male and female who must have been designed by Providence originally as human gad flies. I am not a Hindu and don't know much about this here transmigration stuff, but I am willing to bet any reasonable amount up to $1.50 that in a former state of existence several of my customers carried spears and poison sacs and were members in good standing in the ancient and vicious tribe of Misskitties. As an evidence of good faith and to show that I have the courage of my convictions I am willing to bet another $1.50 that in a future state these same people will appear in the form of hornets or some equally obnoxious and useless species of pests. You know the kind I mean, these lads with yellow bands around their waists who live in a cute little house by the side of the road waiting for a chance to extend a warm, cordial and enthusiastic welcome to the unwary visitor. The only trouble with them is that they extend the welcome wrong end first.

"Some of these people—the customers, not the hornets—would try the patience of a canonized saint. But the kids! Say—I know old Herod started in on them pretty young, but believe me he had the right dope, and I am for him, strong.

"Young imps come here with a nickel gripped in their grimy little paws and take up half an hour of my time while they are making up their grimy little minds how they are going to spend it to the best advantage for themselves. They insist on being shown practically everything in the store although they know perfectly well and I know just as positively that eventually they will depart with an all day sucker on which my profit is approximately one-tenth of one per cent. Business? This is not a business at all. It is nothing but a gamble, with me on the short end of the stick. For example consider my experience a few months ago.

"Just before Valentine day I laid in a stock of penny valentines. You know the horrible daubs our dear little rising generation loves to send anonymously to teachers and other friends. I confidently anticipated a modest profit of a few dollars on the collection. I arranged an attractive display in a large open box where any normal person could examine them and make a selection without disturbing the whole outfit. The vanguard, or perhaps more properly speaking, a few scouts from the school army came dribbling in at noon time and looked them over. They edged up pretty close, but the instant I saw them laying their hands on the collection, I chased them out through the door.

"After school hours the scouts returned with reinforcements and with a joyous and combined yelp proceeded to surround the box. I like to see enthusiastic customers, but these lads were too enthusiastic. Instead of each one quietly selecting a specimen, paying for it and retiring in regular order to make room for others, the whole mob dipped its paws into the collection at one time. So far as I could see the young imps seemed to think I had arranged a special game for their benefit in which the object was to snatch the valentines from each other. In about three seconds the box was empty. Half the valentines were torn and the remainder were scattered all over the floor and tramped under foot. I give you my word if I had my wish at the moment I could have taken the whole gang out in to the middle of the lake and dropped them overboard with a couple of old

BETWEEN THE DARK AND THE DAYLIGHT • • • THERE'S A LULL IN THE DAY'S OCCUPATION THAT IS KNOWN AS THE CHILD REN'S HOUR

grate bars tied to each of their individual villainous little feet.

"I dropped in amongst them kind of promiscuous, like that Assyrian bird in the story whose cohorts were gleaming with purple and gold. I pass on the purple and gold stuff, but when I rapped some of their little knobs together I bet they were reminded of the sheen of the spears that looked like stars on the sea. The band remained discreetly at a reasonable distance while I gathered the papers and replaced them in the box. Then I invited the young cubs to return two at a time to make their selections. The first lad picked a valentine that appealed to his depraved taste and tendered me a penny in payment. He clumsily dropped it, whether by accident or design I don't know although I have my suspicion, and it rolled into the open, hot-air register in the floor. Well, a penny is a penny and while I was on my hands and knees attempting to retrieve it I looked up just in time to see the second young vandal slipping half a dozen valentines inside his dear little blouse. I grabbed him by one of his cute little ears and dragged him to the door, chased the remainder of the gang out after him and then took the stock of valentines out into the back yard and burned them in the waste paper incinerator. Business! Say, mister, there ain't no such animal any more."

Bill expressed his sincere sympathy over the conditions with which the young man was surrounded and at the same time warmly commended him on the prompt and decisive manner with which he had handled a delicate situation. In fact he regretted exceedingly that he had not been present to witness the engagement and the rout of the enemy. Together we left the store and while walking along toward home Bill said that apparently these store keeping fellows had their own troubles.

"Heretofore," said he, "I had a general impression that foundrymen had a monopoly in that line. Do you remember some slight debate we had recently on the subject of sashweights and the many methods available for their production under various circumstances. In many foundries where these castings are considered more or less as fillers the patterns are mounted on matchplates, either wood or metal. The sand may be rammed by hand and the molds may be made either on the bench or on the floor, depending upon the size of the castings. This type of pattern equipment also lends itself readily to use either with a jolt or squeeze machine, hand or power operated. One of the advantages of this method is that the patterns present no particular difficulties in construction and are within the capacity of any intelligent woodworker where the services of no regular patternmaker are available.

"Instead of turning the patterns from solid blocks as described in a former method, each pattern is turned from two pieces joined by two ¼-inch dowel pins. The two pieces are placed in the lathe as a unit and turned to the required diameter. Then they are separated and attached opposite each other on the pattern board. The dowel pins are removed from the patterns and the holes are utilized to locate the holes in the pattern board. The process of matching the patterns on the board presents no theoretical difficulties, but extreme care is required to bore the holes accurately. Unless the half patterns are located perfectly in line with each other on opposite sides of the board it is apparent that the resulting castings will show a *shift* along the joint lines.

Attaching the Patterns

"The drag halves are placed on the board about 1 inch apart, parallel with the sides of the board and with a margin of ½ to 2 inches between the outside of the pattern and the inside of the flask. A 3 or 4-inch margin is left at the end where the runner is located. The minimum margin is provided if iron flasks are to be used and the maximum clearance is allowed if the castings are to be made in wood flasks. The castings are comparatively heavy and soon will char the joints of wood flasks if a generous thickness of sand is not placed inside the wood.

"The patterns are screwed firmly to the board and the heads of the screws are concealed with putty in countersunk holes so that the patterns will present a smooth, uniform surface. A ¼-inch bit is inserted into each dowel hole in turn and the hole is extended through the board. Dowel pins approximately 4 inches long are forced through the holes until they project about 1½ inches on the lower side. The board then is reversed on the bench to bring the blank face on the upper side. The cope halves of the patterns which previously had been marked 1, 2, 3, etc., or in some other suitable manner to identify them, are located in place by the dowel pins. It is apparent that if the holes have been bored accurately and perpendicularly the two halves of each pattern will be located accurately in relation to each other. In the original arrangement the joint surfaces touch each other and the outlines coincide. In the second arrangement they occupy the same relative position with the thickness of the pattern board between them. Before attaching the cope patterns permanently it is advisable to make a trial mold. The cope is lifted off and a handful of flour is sprinkled over the drag joint. The mold is closed and opened again to see if the edges of the individual weight molds coincide perfectly. If necessary, minor adjustments may be made in the position of the patterns and then they are screwed permanently to the board.

"Miscellaneous flasks may be employed with this type of pattern equipment. It is not essential that the flasks should be interchangeable. Where certain types of molding machines, adapted to ramming cope and drag at the same time, are available, two pattern plates or boards are required. Each plate is provided with a set of half patterns. They are attached accurately at equal distances from a center line so that when the drag is rolled over, the mold imprints in the cope will coincide with those in the drag. With this type of equipment it is essential that the flasks be interchangeable The positions of the guides are laid off accurately from a center line and the pin holes are drilled through a jig. In either case a suitable runner consisting of a long member and several short branches extending from the parent stem to each individual pattern, is attached to the drag side of the board. The pattern and board is covered with shellac varnish and after it has dried the equipment is placed in production."

"Why don't you write a treatise on the subject?" I said. "Judging by the widespread interest displayed by foundrymen in the subject of sashweight castings you should find no trouble in selling a few million copies, retire on the proceeds and live happily ever after."

"You are all right in some ways," said Bill, "but your bells don't ring. The majority of foundrymen hate to read and they never buy a book. Have you ever read the fable of the Book Agent and the Colored Elevator Operator? The Book Agent entered the Cage of a big office elevator and tried to interest the Colored Attendant in the Merits of a Flossy book entitled The Complete Elevator Man. He employed all the Stock arguments, but failed to make any Impression. Finally he appealed to the man's Cupidity and assured him that his Value to his Employer would be increased to an Unbelievable extent if he Drank from the Fountain of Knowledge contained in the Book. The son of the Sahara wearily waved him on his Way. 'Boy,' says he, 'You says Words but dey don't mean Nothin' to you an' Less to Me. I ain't gettin' paid for Half what I knows right Now!' "

A Small Cupola Must Be Carefully Charged

Question: We have taken off a few heats in a small cupola 18 inches in diameter and should like to have your opinion on whether our air supply is sufficient or not. The iron is fairly good and is machineable but the piston castings develop pin holes during the machining operation.

The fan which runs at a speed of 2200 revolutions a minute is 24 inches in diameter, provided with paddles 5 inches wide and enclosed in a wooden case having an 8-inch opening on each side. A 6-inch main pipe leads from the fan to a point back of the cupola where it divides into two branches connecting in turn with four tuyeres equally spaced around the circumference of the cupola shell. The tuyere openings are 2 inches in diameter. From the bed plate to the center of the tuyeres is 10 inches and from the tuyeres to the top of the cupola is 5 feet 9 inches. We use from 140 to 150 pounds of coke on the bed and stop up 5 or 6 minutes after putting on the blast. The iron melts at the rate of about 30 pounds a minute but up to the present we only have melted small heats of 500 pounds.

Answer: Apparently your air supply is satisfactory. A cupola 18 inches in diameter should melt about 2000 pounds an hour. You state that you are melting at the rate of 30 pounds a minute which would amount to 1800 pounds an hour. However, since you have taken off only small heats of 500 pounds your performance hardly can be regarded as a fair test. If your cupola can maintain the same melting speed for an hour or two you can rest assured that your practice is all that could be expected in this case.

The pin holes in the piston castings may be due to your molding practice. If the sand is too damp, or if the cores are too hard or if the vent does not escape freely the castings will be spongy. If you are satisfied that the sand or the cores are not to blame then you might turn your attention to the cupola. If the bed in the cupola is too low or if the blast is too strong, then the iron will be oxidized and the resulting castings will contain pin holes.

You do not state whether you divide the 500 pounds of iron into two or more charges. While 140 pounds of coke on the bed should be ample, still 500 pounds of iron is too much for one charge in such a small cupola. Before that amount of iron can be melted the bed will be burned away to a point where the latter part of the charge will be oxidized. It would be better to charge 200 pounds of iron on the coke bed and follow this with between 30 and 40 pounds of coke, then a second charge of 200 pounds of iron and so on until the necessary amount had been charged. Of course, the pig iron and scrap should be broken into small pieces before being charged into a small cupola.

FAKED FOUNDRY FACTS

A PLAIN JOLTER

Watertown Represented

In the article by V. E. Hillman, director of research, Crompton & Knowles Loom Works, Worcester, Mass., which appeared in the March 15 issue of THE FOUNDRY, mention should have been made that the work was carried on at the Watertown arsenal, Watertown, Mass and the equipment shown represents the facilities of that institution for X-ray investigation.

When Is Maintenance a Capital Increase

Whether or not a certain expenditure on property should be expensed or capitalized, and whether or not it actually *is* expensed or capitalized appear to be two different questions, according to a recent publication of the American Appraisal Co., Milwaukee. One takes into account its justification from a theoretical accounting standpoint. The other considers the essentially practical situation resulting from existing income tax legislation. The policy of *charging it to* expense characterizes the present-day administration of business. Aside from any advantages or virtues, this practice is likely to lead to certain preventable wastes in the adjustment of firm insurance losses, unless careful provision is made against it. For example: A firm owns a property upon which would show an acrued depreciation of 20 per cent. The cost of reproduction is $20,000 and the sound value accordingly is $16,000. The company's insurance is placed accordingly. Not long thereafter extensive repairs are made: The floor joists are replaced, most of the flooring is renewed, the roof trusses renewed and strengthened. These are charged to expense being considered in the nature of maintenance. In reality these were replacements. They added materially to the life of the structure. They enhenced its value. They decreased the amount of accrued depreciation. Proper adjustment of the insurance coverage should have been made, but this was overlooked and if a fire had occurred the company would have lost money unnecessarily. This instance may appear to some to be exaggerated in character, yet it actually happened and it is repeated day in and day out by many well-managed institutions. The sum total of these errors throughout a plant of any size constitute an uncertainty of magnitude.

The preventative is, of course, a careful review of all expenditures on property by someone familiar with property—someone capable of accounting for the effects of expenditures as well as for the mere act of spending.

The Donner Steel Co., Inc., Buffalo, N. Y. has established a district offices in the Union Trust building, Cleveland.

Pattern Cost Lowered by Caring for Lumber

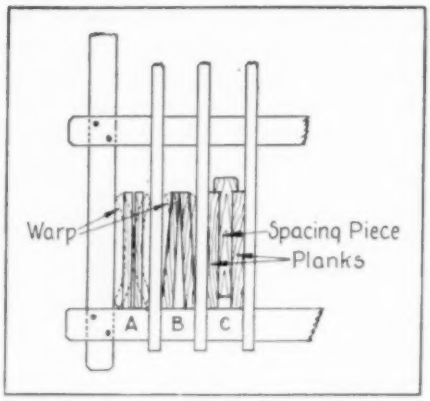
By M. E. Duggan

Often the charge made for patterns seems high to the foundrymen or customer, especially when a check shows the actual amount of lumber used is much less that that included on the invoice. In many cases, this waste of lumber is due to stacking the material improperly in the pattern shop storage, which results in warped and twisted stock. An example may be cited where the bill for a pattern was presented and the material item called for 125 feet of 1½ inch clear pine lumber. Upon checking the pattern, it was found that 40 feet actually were in the pattern, and allowing 10 feet for cutting and working, 50 feet appeared to be a reasonable amount to include in the cost. At the same time the thickest board in the pattern was ⅞ inch dressed on both sides, although the charge called for 1½ inch stock. However, consideration of certain factors shows this bill was not excessive.

A wide piece sometimes must be used since it is difficult to find stock free from warping, although in other respects the lumber may be sound and serviceable. Where a long pattern is being made, a slight amount of warping will necessitate dressing down a considerably larger piece. If the pattern maker tries to use stock approximately the size required in the finished piece, it is possible that the pattern will not finish true and it will have to be made over.

About three years ago the writer purchased 3000 feet of clear pine lumber 1, 1¼, 1½ and 2 inches thick. This was divided into two lots, approximately 1500 feet being placed in a rack suspended from the ceiling and the remainder stacked on the floor. Great care was taken in piling the lumber on the floor. Starting at the bottom, strips ⅞ inch in thickness were laid down three feet apart and carefully leveled. The bottom board was level when placed on the strips. Each pile of lumber, made up of different thicknesses was piled in the same manner with strips between. The piles remained on the floor of this shop for a year and when removed the lumber was true.

In the racks used to store the remaining 1500 feet near the ceiling the vertical division strips were 2¼ inches apart. This division was intended for storing a 2-inch, 1½-inch or two 1-inch plank. A study of *A* and *B* in the accompanying illustration shows the result of storing lumber in this manner. In one shop where the writer was employed the space for 2-inch lumber was made 2½ inches. In case it was found necessary to store 1-inch lumber



CARE SHOULD BE TAKEN IN STORING LUMBER IN RACKS—A GOOD METHOD IS SHOWN AT *C*

in this section, pieces of wood were used between the planks as shown in *C* of the accompanying illustration. In this way the lumber was kept free from warping, an item which materially reduced the cost of the pattern.

Sand Sticks to Pattern

Question: Do you know of any solution or mixture that will prevent patterns from becoming damp. Each of our patterns is used to make approximately 200 molds a day and along in the afternoon the pattern becomes so damp that the sand sticks to it and causes a drop. At present we employ a mixture of gasoline and bayberry wax to keep the patterns clean.

Answer: Bayberry wax and gasoline are employed satisfactorily either singly or together for preventing sand from sticking to metal patterns and this fact leads us to wonder if perhaps some other factor than the coating of the patterns is not responsible for your trouble. Undue dampness of the sand will cause it to stick, so will a combination of hot sand and a cold pattern. Again, in the hands of an inexperienced man the very agent intended to prevent sticking, may cause it. An overdose of gasoline is as bad as none. A man who is not familiar with this characteristic probably will argue that if a small dose is good a large dose is better and on that basis he slushes the pattern.

Usually a coating of bayberry wax is all that is required to keep patterns in good molding condition. The wax is heated until it melts and then is applied like paint to the thoroughly cleaned pattern. After it has cooled it is polished with a fairly stiff bristle brush, known in the foundry as a *hard brush*.

The plant of the American Bell & Foundry Co., Northville, Mich. has been sold to Parker & Genkins, Howell Mich. The plant will be operated under the name of the American Bell & Furnace Co.

Twin Cupolas Melt Wheel Iron

(*Concluded from Page 293*)

under various names that forms the lightening chamber between the webs of the wheel. The method and equipment for making this latter core are shown in Fig. 9. The empty corebox is shown to the right, a dried core is in the center and the spider or jig for setting the steel chaplet loops is shown in place on a green core to the left. Iron is tapped into a 5-ton receiving ladle and then transferred in the manner shown in Fig. 1 into several 1000-pound ladles and conveyed to the various floors. A regular schedule is observed in this respect so that each floor in turn is poured first. Thus the man who is poured first on one day will be last on the following day and progress ahead one step each following day until he once more is first.

The movement of the reservoir ladle, also the movement of the small ladles along the track are controlled electrically from an enclosed pulpit built around one of the columns about 20 feet back from and in front of the cupolas. In the illustration Fig. 1 a man is shown leaning against the housing which covers the ladle tilting gear. The buggy ladles on the track are pulled back and forth by a steel cable running over a sheave at each end of the track. The ladle is spotted in front of the desired floor and the ladle is picked up by the crane, poured and returned to the carriage which takes its back to the reservoir ladle.

After the wheels are poured, they are shaken out and loaded on a steel carriage operated in the same manner as the ladle buggy. The load of wheels first is pulled to a station where the heads are knocked off and then down to the passage between two batteries of annealing pits as shown in Fig. 10. The carriage enters between two long rails mounted rigidly at one end, but attached to a pair of movable uprights at the end shown in the foreground. The rims of the wheel castings resting horizontally on the carriage, clear the long rails on the way in. Then the ends of the rails are raised and the wheels are lifted clear of the carriage. The carriage is removed and returned to receive another load and the wheels on the long rails are picked up by a crane and lowered into the annealing pits, where they remain for four days. Brief reference is made to the general features of wheel manufacture, because the subject was covered exhaustively a few years ago in a series of articles written for THE FOUNDRY by the late H. E. Diller. The series began with the April 1, 1920 number.

Describes Enamels Used for Cast Iron

The department of commerce has issued pamphlet No. 246 describing the investigations carried on by R. R. Danielson, technologist and H. P. Reinecker, assistant chemist, relating to wet process enamels for cast iron.

The first part deals with the wet-process enamels with the use of a ground coat, and an experimental study of ground coats, their preparation and application together with tables showing the effects of varying mill additions.

These investigations show that all ground-coat compositions are not necessarily suitable for both the dry and wet process, although, certain compositions apparently may be used with good results for either type of cover enamels. The preparation of ground coats for the wet process requires more care than is necessary in the dry process enameling of cast iron, and best results are obtained where the cover-enamel is adapted to the ground coat refractoriness. Excessive additions of raw materials to the mill batch for ground coats should be avoided as they give rise to such difficulties as blistering and crawling of the enamels. The accompanying tables, I and II, show a few typical examples of satisfactory ground-coat frits, and white-cover enamel frits.

Methods of using the wet-process enamels without the use of a ground coat are described in the second part of the pamphlet with the preparation of single coat colored and white enamels. This portion contains numerous tables showing the different results obtained in varying the different ingredients used in their preparation. These investigations were conducted not only in the laboratory, but under regular factory conditions where full size commercial batches were made and applied to stove castings. These investigations have resulted in the development of a number of satisfactory compositions for the enameling of cast iron by the wet process and obtaining a maximum capacity in the frit. The accompanying tables, III and IV, show a typical frit composition and mill batch for single coat colored and white enamels.

Production and Use of Aluminum in 1923

According to statements prepared by James M. Hill of the geological survey, the value of new aluminum produced in the United States during the year 1923 was $28,305,000 being more than double the value produced in 1922. The advance in consumption was largely due to the increased use of the metal in automobile construction. It is estimated that 25 per cent of the domestic aluminum produced is consumed by the automobile industry which used approximately 72,700,000 pounds of this metal in 1922.

During the year 1923 the development of silicon aluminum alloys was far reaching. Silicon at one time was looked upon as harmful to the metal and in the mining of bauxite every precaution was taken to remove silicon and only the higher grades were utilized. At present consideration is being given to the lower grade ores.

During January 1923 domestic aluminum was quoted for the 99 per cent grade at 22 to 23 cents. In April of the same year the price had advanced to 27 cents per pound at which point it remained practically stationary for the remainder of the year. The 98 per cent grade was quoted at 1 cent lower, and the imported metal was quoted at a still lower figure.

Gives Casting Data

Edgar Allen & Co., Ltd., Sheffield, England, recently have issued a 32-page booklet entitled "The Edgar Allen Steel Foundry Book." In this publication considerable information is included which is of importance to the user and buyer of steel castings when placing orders or inquiring for material. The functions of the various departments of the foundry are discussed and much of the book is devoted to instructions on how to order steel castings. The remainder of the booklet contains discussions on steel castings of intricate design, manganese steel castings and cleaning steel castings. The booklet is well illustrated with views of the foundry and a number of the castings made there.

Table I

Ground-Coat Frits

Batch composition to give 100 parts of melted frit

Materials	Rg-26	Rg-17	Rg-1	Rg-25	Rg-18
Flint	66.30	69.90	69.90	69.90	69.90
Borax	36.96	36.96	36.96	26.07	26.07
Sodium nitrate	6.95	6.95	6.95	6.95	6.95
Soda ash	....	....	....	9.88	3.04
Red lead	8.17	4.08	8.17	8.17	12.24
Boric acid	6.37	7.08	....	....	....

Mill Batch for Ground Coats

	Parts
Frit	100
Clay	15
Water	60

Table II

White-Cover Enamel Frits

Batch compositions for 100 parts of melted frit

Materials	R-14	R-11	R-28	R-1	R-18
Feldspar	38.0	33.0	40.0	38.0	33.0
Flint	12.0	12.0	...	12.0	12.0
Borax	10.9	24.52	54.5	24.52	24.52
Sodium nitrate	6.2	6.20	5.95	6.20	6.20
Soda ash	7.7	3.86	...	3.86	3.86
Red lead	21.6	21.60	10.3	16.42	16.42
Zinc oxide	6.0	6.0	5.0	6.0	6.00
Fluorspar	5.5	5.5	5.5	5.5	5.50
Cryolite	5.0	5.0	...	5.0	10.00
Barium carbonate	...	...	4.5	...	...
Boric acid	...	...	8.85	...	...

Mill Batches for White Cover Enamels

	Parts
Frit	100
Clay	5
Tin oxide	8
Water	45

Table III

Frits for Single-Coat Colored Enamels

Batch compositions to give 100 parts of melted frit

Material	Rh-14	Ro-5	Ro-6	Ro-7
Flint	47.70	....	....	....
Feldspar	....	47.05	47.05	47.05
Borax	36.96	50.57	36.94	23.32
Sodium nitrate	6.95	4.63	4.63	4.63
Red lead	30.81	22.71	22.71	22.71
Soda ash	....	3.90	7.64	11.42

Mill Batch for Single-Coat Enamels

	Parts
Frit	100
Clay	4
Color	As required
Water	45

Table IV

Single-Coat White Enamel

Batch composition of frits

Material	Ro-16	Ro-38
Feldspar	45.05	45.05
Borax	50.57	39.67
Sodium nitrate	4.63	4.63
Red lead	22.71	22.71
Soda ash	3.85	6.87
Antimony oxide	2.00	2.00
Cryolite	....	4.00

Mill Batch

	Parts
Frit	100
Clay	4
Tin oxide	4
Water	45

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Working Knowledge Valuable Asset

CONTRARY to a generally accepted opinion among outsiders, founding in metals is a highly technical profession in which one cannot become proficient without close and intensive application over a period of many years. It involves chemistry, engineering, finance and business adminstration to such an extent that no man can hope to become a specialist in all the varying ramifications. Theoretically, he may acquire a hazy knowledge of the subject but the instant he attempts to put his theoretical knowledge to the test of practical application he finds that some important detail is missing and he does not know whether he ever knew it or just simply has forgotten it. In either case his initial effort is wasted and he is forced to try again. He finds that preconceived ideas based on a greater or less amount of undigested information are totally erroneous and only serve to lead him into trouble. Even specific rules in many cases are nullified by peculiar local conditions and nothing but a series of actual experiences will prove conclusively that practice obtaining in one foundry may not be applied to another.

The celebrated lawyer who tried to insist on a direct yes-or-no answer to every question and then was confounded by the badgered witness who asked him to answer either yes or no to the question: "Have you stopped beating your wife?" was not in a more embarrassing position than the foundryman who sometimes is asked to give a definite ruling on some disputed point. For example: What is the best mixture for cores for iron, steel and brass? What is the percentage of good castings to the total amount of iron melted? How many pounds of castings is considered a good day's work for a molder? Theoretically there is only one best mixture and yet any foundryman of experience knows that in many cases a mixture that gives perfect satisfaction in one foundry will not be tolerated in another. The proportion of the various ingredients may be the same and yet something in the chemical composition of the sand will produce cores that are not alike in anything excepting outward appearance.

Offhand one naturally would assume that there is a relative proportion between the amount of iron melted and the total weight of good castings. Certainly there is, but it is not the same in all foundries. On certain classes of castings, for example, ingot molds, the sprue will not amount to 1 per cent while on stove fittings and hardware the sprue will amount to 50 per cent.

The feature at which the non-practical foundryman balks most resolutely is the wide discrepancy observed between the daily output of different men working in the same shop and paid on the same daily or hourly rate. Usually the castings are sold on a pound basis and naturally it is disconcerting to find that one molder is paid $7.00 for making 1000 pounds of castings while a second man is paid the same amount for an output of 300 pounds. Obviously the remedy is to charge twice as much for the castings made by the second man, or to speed up his production. On the first count the foundryman finds he is blocked by the prices charged by his competitors. Eventually, if he stays in business long enough, he learns that certain castings lend themselves more readily than others to tonnage records.

Many systems have been developed in recent years with a view to supplying a method of determining actual operating costs, but none has been presented that can be applied successfully by a man who is not already in possession of a good working knowledge of the foundry business in its various ramifications.

Trade Outlook in the Foundry Industry

CAUTION, untinged by fear, characterizes the general tone of industry. While many lines report tapering off in demand, inventories are not excessive, retail trade is active, freight movements continue at a high level, and employment figures indicate little decrease in manufacturing activity. In the foundry industry, the outlook is by no means uniform over the entire country nor in a cross section through any single branch of castings production. While automobile cylinder shops have cut their operating schedules, general jobbing work is increasing slightly and railway, agricultural and plumbing castings are in demand.

Automotives Trim Sail

A pronounced check has been encountered in automobile production and the manufacturers have cut their output and restricted their castings demand in proportion. The slowing down is ascribed to the effect of the late spring on sales and a desire on the part of makers to refrain from overstocking dealers at the start of the season. The effect upon automotive foundries has been pronounced. One large shop making in excess of 2000 cylinders a day has cut its schedule to 500 a day. However, the Ford Motor Co., Detroit reports deliveries during the last 10 days of March show an increase over the first 20 days of the month. Several large interests in the Detroit district have restricted their output by 10 or 15 per cent. This is particularly true among makers of medium priced cars. Nonferrous foundries specializing in automotive products also have felt the drop in demand, and the consumption of copper and zinc among these interests shows a marked decline. Truck sales constitute an exception and are reported satisfactory.

Prices for Raw Materials for Foundry Use

CORRECTED TO APRIL 8

Iron		Scrap	
No. 2 Foundry, Valley	$25.00 to 26.00	Heavy melting steel, Valley	$17.00 to 17.50
No. 2 Southern, Birmingham	22.00 to 23.00	Heavy melting steel, Pitts.	17.00 to 17.50
No. 2 Foundry, Chicago	24.50	Heavy melting steel, Chicago	15.00 to 15.50
No. 2 Foundry, Philadelphia	23.63 to 23.76	Stove plate, Chicago	18.00 to 18.50
No. 2 Foundry, Buffalo	21.50 to 22.00	No. 1 cast, Chicago	21.00 to 21.50
Basic, Valley	21.75 to 22.00	No. 1 cast, Philadelphia	19.00 to 20.00
Basic, Buffalo	21.00 to 22.00	No. 1 cast, Birmingham	19.50 to 20.00
Malleable, Chicago	24.50	No. 1 cast, Buffalo	19.00 to 19.50
Malleable, Buffalo	21.50 to 22.00	Car wheels, iron, Pittsburgh	18.50 to 19.00
Coke		Car wheels, iron Chicago	18.00 to 18.50
Connellsville foundry, coke	$4.75 to 5.00	Railroad malleable, Chicago	20.50 to 21.00
Wise county foundry, coke	5.00 to 6.00	Agricultural mal., Chicago	19.25 to 20.25
		Malleable, Buffalo	20.00 to 20.50

Pig Iron Sluggish

Foundries are buying pig iron only for immediate needs. Stocks are not excessive, but expectation of lower prices is influencing many to refrain for forward purchases. Upper lake ore prices at the opening of the shipping season are 80 cents lower than last season. This, coupled with a decline of practically 75 cents a ton in the price of coke since the first of the year is expected to bring lower production costs on northern irons. Production of pig iron according to statistics compiled by *Iron Trade Review* reached a total of 3,435,813 tons in March, an increase of 363,648 tons over the previous months output of 3,072,165 tons. Further, six more furnaces were active on the last day of March than were reported at the end of February. The production of merchant iron in March was 704,582 tons compared with 679,700 tons for the previous period. On a daily average basis, the comparison is not so favorable, as March showed an average of 22,728 tons per day compared with 23,438 tons for February. This constitutes a loss of 710 tons per day. A gain of two active merchant furnaces is noted for March.

Implement Outlook

Reports from farm implement manufacturers are conflicting. Early spring orders have been satisfactory and operations are expanding. Sales have been more active in the corn belt and from diversified interests, while the wheat section still is suffering from depressing influences of the past fall. Freight car loadings show a slight decline, although the last week of March still was comfortably above the high figure of 900,000 which has obtained during the past few months. Car buying is lagging, and repair orders are not so plentiful, but a fair business for 1924 is expected. February building awards showed a decrease of 4 per cent as compared with the first month of the year, but still the total was 15 per cent ahead of February, 1923 and 36 per cent ahead of the corresponding month of the preceding year. An increase in malleable casting production was noted in February, according to the department of commerce, operations averaging 61.9 per cent of capacity, compared with 58.6 per per cent for the preceding month. Orders dropped slightly below output, the sales being 62,562 tons compared with an output of 65,829 tons for the firms reporting. Foreign shipments of gray iron castings totaled 950 tons and of steel castings about 960 tons for February. Cast iron pipe demand is increasing with the advance of spring and the resumption of municipal requirements. According to the department of commerce, a total of 182,649 tons was specified to be made while the production was 78,962 tons during February. These figures may be compared with orders for 171,941 tons and an output of 81,431 tons during January.

Nonferrous Active

Plumbing goods brass foundries are active and have not yet matched the stride of demand for this class of castings. Nonferrous foundries making automotive castings report a falling off in business. Copper production has declined and stocks are low, but advances are noted in tin and aluminum. Prices on nonferrous metals based on New York quotations in the *Daily Metal Trade* of April 9 follow: Casting copper, 13.12½c to 13.25c; electrolytic copper, 13.50c; Straits tin, 51.00c; lead, 8.50c; antimony, 9.62½c; nickel, 30.00c; aluminum, No. 12 alloy, open market, 23.00c to 24.00c. Zinc is 6.30c, E. St. Louis, Ill. Average monthly prices for March follow:

(New York Quotations)

Casting Copper	Electro Copper	Lead	Tin Straits	Antimony	Aluminum 98-99	Zinc St. Louis
13.49	13.841	9.341	54.99	11.55	27.42	6.49

Personal

W. D. Moore has been elected president of the American Cast Iron Pipe Co., Birmingham, Ala. Mr. Moore has been vice president and works manager since 1922. He became associated with the company in 1908, a year after he went to Birmingham from Galion, O., with the Tennessee Coal, Iron & Railroad Co., working his way through the various departments. He is the inventor of a new method for making centrifugal cast pipe which is to be tried on an extensive scale during the year.

John Sherman Hoyt has been elected a member of the executive committee of the American Car & Foundry Co., New York, succeeding the late H. Rieman Duval.

W. Howard Kane, formerly connected with the Sheeler-Hemsher Co., Philadelphia, has been made general manager of the McHatton Foundry Co. of that city.

Dr. Richard Moldenke, Watchung, N. J. addressed the New England Foundryman's association April 9, at Boston on the subject "A Foundrymen's Experience in Europe in the Fall of 1923."

J. Edmund Waechter formerly connected with Brown & Sharpe Mfg. Co., Providence, R. I., has accepted a position as metallurgist and engineer with the General Chemical Co., 40 Rector street, New York.

James Rountree, for 14 years foundry superintendent for the American Locomotive Works, Dunkirk, N. Y. will be in charge of the foundry to be built by the Ward Railway Equipment Co., Lima, O.

John D. Miller, superintendent of foundries for the Geo. V. Cresson Co., Philadelphia, was scheduled to address the Philadelphia Foundrymen's association April 9, on the results of his experience in the iron foundry business.

William W. Coleman was re-elected president of the Bucyrus Co., South Milwaukee, Wis., at the recent meeting of the stockholders. The Bucyrus Co. manufactures steam shovels, etc., and operates gray iron, brass, steel and aluminum foundries.

Arthur N. Leedy has been appointed foundry manager of Hiram Walker & Sons Metal Products, Grey Iron Foundry, Walkerville, Ont., succeeding Jos. J. Wilson, who recently resigned. For the past two years Mr. Leedy has been foundry superintendent of the Walker company.

R. R. Fauntleroy, president of the Moline Malleable Iron Co., St. Charles Ill., will speak before the malleable meeting of the Quad City Foundrymen's association, April 21, at the Davenport chamber of commerce, Davenport, Iowa. Mr. Fauntleroy is the immediate past president of the American Malleable Iron association.

Obituary

James Hunter Sleeth, aged 63 years, general foundry foreman, died on Saturday, March 8, at his home, 319 Lehigh avenue, Pittsburgh, after a brief illness of pneumonia. Mr. Sleeth had been connected with the Westinghouse Air Brake Co. foundry at Wilmerding, Pa., continuously for almost 50 years. He was a son of James Sleeth, the first foundry foreman employed by George Westinghouse when the company was formed, and a brother of S. D. Sleeth, who retired about a year ago as general foundry superintendent and is now the company's consulting foundry engineer.

Mr. Sleeth joined the Air Brake company in 1875 as a coremaker. He learned the molding trade and in addition to being an efficient workman demonstrated the ability to assume supervisory responsibilities, which led to his promotion to the foreman position. In private life he was much of a student, artistically inclined, fond of books and music, and in his home he had a fine library of which he was justly proud. He is survived by his widow.

William H. Starke, vice president of the Central Foundry Co., New York, died in New York, March 22. He was 45 years old and has been connected with the Central Co. since 1907.

Robert H. York, president the Berkshire Mfg. Co., molding machine manufacturer, the Metropolitan Motor Insurance Co. and the Cleveland Heights Savings & Loan Co., and director of the Sterling-Knight Mfg. Co., died March 15 at his home in Cleveland Heights, a suburb of Cleveland, aged 60 years.

C. L. Prince, for 25 years associated with the General Electric Co., Schenectady, N. Y., in iron foundry work, and one of the pioneers in the American Foundrymen's association, died March 20 at the age of 67. Mr. Prince was born in Georgetown, Mass. and was graduated from the Ridgewater State Normal school and Worcester Polytechnic institute. Previous to his connection with the General Electric Co., he was employed by the Camden Iron Works, Camden, N. J.

Charles Allen Munn, editor and publisher of the *Scientific American*, with which he had been associated 43 years, died April 3 at his home in New York, aged 65. Mr. Munn was a son of Orson D. Munn who became interested in the *Scientific American* in 1846 which then was a year old. The firm of Munn & Co. was organized at that time for the purpose of publishing this paper. Charles Allen Munn graduated from Princeton in 1881 and also studied abroad.

Offer Ferromanganese

A new alloy of ferro manganese has been developed by deCourcy Browne, Inc., 120 Broadway, New York. The analysis of this metal is given as follows, four different grades being offered:

Manganese Per cent	Carbon Per cent	Silicon Per cent
85	0.35	3.00
82	0.75	1.00
91	0.50	6.00
70	0.50	20.00

This alloy is offered for use in making manganese, low carbon, nickel and other special steels, monel metal and manganese bronze alloys.

Plan Technical Group

Plans have been completed for the organization of the Tri-City Technical council with the following organizations represented: American Chemical society, Illinois-Iowa section; American Society of Mechanical Engineers, Tri-City section; American Society for Steel Treating, Tri-City chapter; Davenport Engineer's club and the Quad City Foundrymen's association. The following temporary officers have been elected: H. Bornstein, Deere & Co., Moline, Ill., chairman; Howard Rogers, William-White Co., Moline, vice chairman; Harvey Soverhill, Davenport Locomotive Works, Davenport, Ia., secretary. One of the purposes of the organization of the council is to increase the civic activities of the technical men and organizations of the Tri-Cities.

Buys Machinery Plant

The Honolulu Iron Works, Honolulu, T. H. recently absorbed Catton, Neill & Co., Ltd. of that city. Both companies had branches in Manila P. I. and build sugar mill machinery and general equipment. Officers and directors re-elected at the recent annual meeting were; President, T. Clive Davies; vice presidents, E. D. Tenney, E. H. Woodhouse, C. Hedemann, W. G. Hall and D. A. Fox; treasurer, J. E. Russell and assistant treasurers, W. B. Craig and C. V. Bennett; secretary, H. Edmonson; assistant secretary, J. G. Rothwell; comptroller.

Robert M. Anderson and directors, J. M. Dowsett, A. W. T. Bottomley, John Waterhouse, R. A. Cooke, George A. Angus and W. C. Shields.

Foundry Contributor Dies in Kenosha

Michael E. Duggan, widely known in the metal working trades from his contributions to the technical press extending over a period of many years, died in St. Catherine's hospital, Kenosha, Wis., on Sunday March 30 after less than a weeks illness from pneumonia. Mr. Duggan had a long and varied career as a patternmaker and inventor and the eminently practical character of the contributions which appeared almost continuously in THE FOUNDRY for the past 6 years attest to his knowledge of a subject which he studied for over 40 years.

MICHAEL E. DUGGAN

He was born in Chicago April 12, 1861 and at an early age was apprenticed to George B. Durkee who conducted a general jobbing pattern shop. He remained with this firm for 6 years during which time the personnel of the owners changed several times. Under doctor's orders, he went to Denver, at the end of his service with the Durkee shop. There he worked for a short time in the pattern shop of the Denver Iron Works. Returning to Chicago he entered the pattern shop of the Union Steel Rolling Mills at the corner of Ashland and Archer avenue, better known as the Archey Road mills.

Mr. Duggan at various times served as foreman in the woodworking department of Lyon & Healey, musical instrument makers, foreman at the North Chicago Rolling Mills, foreman at the Western Wheel Works, designer of special conveyor equipment for the Anglo Packing Co., partner in the Invalid Appliance Co., and for the past 14 years he has had charge of the pattern department of the Kenosha branch of the American Brass Co. He was the inventor of many meritorious pieces of equipment adopted by this company in its various rolling mills.

He is survived by his widow Mrs. Anna McCarthy Duggan and one son Robert G. Duggan who is engaged on his own account in the industrial moving picture business in Chicago.

British Institute of Metals Holds Meeting

At the annual meeting of the British Institute of Metals which was held in London March 12 and 13, papers were read and discussed, dealing mainly with the scientific problems of the non-ferrous metallurgist. Among the papers applicable in some degree to the foundry industry were the following: "X-Ray Studies on the Copper-Aluminum Alloys," by E. R. Jette, G. Phragmen, and A. F. Westgren; "The Effect of Casting Temperature on the Physical Properties of a Sand Cast Zinc-Bronze" by Francis W. Rowe, metallurgical engineer, Stretford, Manchester; "The Cadmium-Lead-Zinc System," by Maurice Cook; and "Copper-Zinc Alloys which Expand on Solidification," by Kei Iokibe, Japanese naval office, London, S.W.1.

One of the most interesting items on the program was the presidential address of Prof. Thomas Turner of Birmingham university, in which the connection between pure scientific research and manufacturing problems was clearly traced. The report of the council shows that the institute now has 1531 members compared with 1436 a year ago and 1410 at the end of 1921. During the past year or so six local sections have been organized, in Birmingham, London, Sheffield, Swansea, the Northeast coast, and in Scotland. The work of the corrosion research committee is reported to have made good progress during the year. Several papers on the causes of rapid corrosion of condenser tubes have been published.

Death of J. J. Eagan

John Joseph Eagan, former president of the American Cast Iron Pipe Co., Birmingham, Ala., died at Asheville, N. C., March 30. Mr. Eagan was born in Griffin, Ga., April 22, 1870. He was educated in the public schools and early entered upon a business career, being associated with his uncle, the late William A. Russell, who headed the American Cast Iron Pipe Co. Mr. Russell also had real estate holdings in Atlanta, Ga. and Mr. Eagan participated in the management of these properties. Upon the death of Mr. Russell in 1899, Mr. Eagan succeeded to his uncle's estate, becoming head of the American Cast Iron Pipe Co.

During his last term as president he inaugurated a plan to make what he called a practical application of the Golden Rule to industry. He instituted policies of industrial government of the company's affairs along the line of democracy. The active conduct of the business has been placed in the hands of a board of management composed of the heads of the more important departments of the organization. In addition, he provided for the election of a board of operatives by the workers as a means of securing direct co-operation between the management and employe. This board of operatives makes recommendations to the management on any subject it may deem of interest to the workers. Two of its members are placed on the board of directors of the company, two act on the board of pensions, and the board has standing committees on living conditions, housing, working conditions, wages, etc. The progressive policies of Mr. Eagan are being worked out in detail and their practical operations are being studied eagerly by all progressive men in the industry.

JOHN JOSEPH EAGAN

For the past two years Mr. Eagan has owned all of the common stock in the American Cast Iron Pipe Co., but has refused to accept any dividends from the earnings of the company until the board of operatives and the board of management agreed that every worker in the organization was receiving at least a decent minimum living wage. He was an outstanding figure among southern industrial leaders.

Equipment Outlook Is Spotted

Large Inquiries Pending for a Period Are Held in Abeyance—Purchases for Replacement and for New Projects Predominate—Automotive Lull Exerts Influence

BUYERS of foundry equipment continue to delay closing of inquiries that have been current for some time. An exception to this condition is noted in the East where a slight increase in the volume of sales is reported. However, good inquiries continue to be brought out in several sections of the country. The Cadillac Motor Car Co., Detroit, has purchased two batch machines, 100 tons a day capacity, from the Standard Sand & Machine Co., Cleveland, and also has closed on other equipment. The Berkshire Mfg. Co., Cleveland has sold a squeezer type molding machine to Marchant's Foundry, Emeryville, Oakland, Cal. Pipe annealing furnaces have been sold to the National Cast Iron Pipe Co., and the United States Cast Iron Pipe & Foundry Co., both of Birmingham, Ala., by the F. J. Ryan Co., Philadelphia. This company also sold a burner system to the Canadian Steel Foundries, Montreal, Que. The Mayor Fuel Saving Furnace Co., Cleveland, has contracted with the United States Cast Iron Pipe & Foundry Co., Columbus, O., for a core oven firing installation. The W. W. Sly Co., Cleveland, reports the sale of tumbling mill equipment to the Dodge Foundry Co., Chattanooga, Tenn., the Cleveland Co-operative Stove Co., Cleveland, and the Dunham Co., Berea, O. James Rountree, for 14 years foundry superintendent of the American Locomotive Works, Dunkirk, N. Y., is in charge of equipping a gray iron foundry for the Ward Railway Equipment Co., Lima, O. The Crown Mfg. Co., Phelps, N. Y., desires information on a small furnace, either gas or oil fired to melt 200 pounds of aluminum at one heat.

Business Light in Pittsburgh District

NUMEROUS foundries in the Pittsburgh district are giving more attention to labor-saving devices and inquiries are particularly heavy. However, sales are light and are confined for the most part to single installations. Several manufacturers of molding machines, tumbling barrels, cupolas and kindred equipment report a fair degree of activity. Sales by the Whiting Corp., Harvey, Ill., include cupolas as follows: one to the Williams Foundry & Machine Works, Cumberland, Md., and one to the Buckeye Foundry Co., Cincinnati, O. Ladles were sold to the William Dee Co., Harvey, Ill.; the Sandusky Foundry & Machine Co., Sandusy, O., and the Bethlehem Steel Co., Bethlehem, Pa. The Canadian Westinghouse Co., Hamilton, Ont., bought several small ladles. In addition to a 2¼-ton hand-power crane, the Clark Equipment Co., Buchanan, Mich., purchased two 3000-pound ladles, the Bartlett Hayward Co., Baltimore, Md., three ladles; the Calumet Foundry & Machine Co., East Chicago, Ind., one ladle; and the Ohio Steel Castings Co., Cleveland, the Vulcan Mould & Iron Co., Latrobe, Pa., and the Fairbanks-Morse Co., Chicago, each bought ladles of 2-ton capacity. The Ainsworth Mfg. Co., Detroit, bought a small tumbling barrel for brass casting work while the Studebaker Corp., that city, purchased 35 tumbling barrels of various sizes from this manufacturer. Other recent purchasers of tumbling barrels include the Rudisell Soil Pipe Co., Anniston, Ala., and the H. W. Caldwell & Son Co., Chicago. The Ford Motor Co., Detroit, purchased three special air hoists and the American Steel Foundries, Chicago, bought two special air jacks. Molding machine inquiries are more numerous. Many of these are for installations of more than one piece of equipment. The largest sale recently reported by the Herman Pneumatic Machine Co., Zelienople, Pa., involved five molding machines to the Saco Lowell Shops, Biddleford, Me. The National Foundry Co., Erie, Pa., bought two while the Westinghouse Electric & Mfg. Co. purchased three for Trafford City, Pa. The Johnsonburg Machine Co., Johnsonburg, Pa.; the American Abrasive Metals Co., Irvington, N. J., and the Tennessee Coal Iron & Railroad Co., Birmingham, Ala., each bought one from the Herman company. The Pangborn Corp., Hagerstown, Md., has sold sand blast equipment to Pratt & Letchworth Co., Buffalo, N. Y., and the Lancaster Foundry Co., Lancaster, Pa., and dust arrester equipment to the American Radiator Co., Buffalo. The Foundry & Machine Co., Wilkes-Barre, Pa., has sold a sand separator and blender to the Vulcan Iron Works of that city. Crane sales to foundries have not been numerous. The Damascus Crucible Steel Casting Co., New Brighton, Pa., bought a 5-ton hoist from the Whiting Corp., Harvey, Ill. The latter builder also sold the Norfolk & Western railroad, Roanoke, Va., a 10-ton 3-motor crane with 69-foot span; and the Wolff Mfg. Co., Chicago, two 5-ton 3-motor cranes with 28-foot span.

New England Buying Still Deferred

DURING the last few weeks New England foundries have failed to buy equipment along the lines expected from earlier inquiry. Several plant additions are under construction and others are contemplated, but the trade obviously lacks confidence and buying of equipment as well as supplies is on a hand to mouth basis. Several sand separators have been purchased during the past 10 days. Among these the Royer Foundry & Machine Co., Wilkes-Barre, Pa., reports three, one to the Malleable Iron Fittings Co., Branford, Conn., one to the H. B. Smith Co., Westfield, Mass., and one to Crompton & Knowles Loom Works, Worcester, Mass. One company handling used foundry equipment reports a decided improvement in sales. A western Massachusetts foundry is in the market for a 15-ton crane. The General Electric Co., West Lynn, Mass., has purchased tumbling barrel equipment from the W. W. Sly Mfg. Co., Cleveland. The Pratt & Whitney Co., Hartford, Conn., has closed on electric furnaces with F. J. Ryan & Co., Philadelphia.

Equipment Buying Better in East

WHILE trade opinions vary as to the extent, little doubt prevails but what buying of foundry equipment in this district has improved slightly. Business since January had been on a declining scale, and while the present improvement may be one of the minor fluctuations that marks the trend of a market, sellers appear hopeful that it will be of greater duration. The building season is at hand and should result in a greater number of new projects, for which equipment should be required. Included in recent buying are one-car type and three-door type core ovens for the Hay Foundry & Iron Works, Newark, N. J., and a 4-ton teapot ladle for Eastern Steel Castings, also of that city, both orders going to the Whiting Corp., Harvey, Ill. The A. Weiskittel & Son Co., Baltimore, recently has added to its pattern making facilities, and is figuring on sand handling equipment. The Central Foundry Co., New York has taken a large pipe order, for which it is buying supplies in substantial volume for its Dundalk plant in Baltimore. The Bartlett Hayward Co., Baltimore,

has purchased ladles and the Williams Foundry & Machine Co., Cumberland, Md., has closed on a 5-ton cupola, both contracts going to the Whiting Corp. Another buyer of considerable miscellaneous equipment is understood to be the Boynton Furnace Co. which is building a new foundry at its present works in Jersey City, N. J. The Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., figuring for some time on miscellaneous equipment, including sand handling machinery, also is reported to be a buyer at this time. The Bullard Machine Tool Co., Bridgeport, Conn., is reported to be contemplating the erection of steel foundry. The International Heater Co., Utica, N. Y., has purchased ladles from the Whiting Corp. The F. J. Ryan & Co., Philadelphia, have sold core oven equipment to the Philadelphia Stove Works Philadelphia. Sand blast and dust arrester equipment has been purchased by the Babcock & Wilcox Co., Bayonne, N. J., and sand blast equipment by the Smith Wheel Inc., Syracuse, N. Y., both from the Pangborn Corp., Hagerstown, Md. The Mayor Fuel Saving Furnace Co., Cleveland, has sold equipment to Eastern Steel Castings, Newark, N. J. Other buyers are the Frog Switch Mfg. Co., Carlisle, Pa., which has purchased sand mixing equipment from the National Engineering Co., Chicago, and the Wheeler Condenser & Engineering Co., Carteret, N. J., which is erecting a new foundry. The Lynchburg Foundry Co., Lynchburg, Va., has closed on a 2-ton wall crane with the Pawling & Harnischfeger Co., Milwaukee. The J. E. Lonergan Co., 211 Race street, Philadelphia, plans to replace the brass foundry which was recently damaged by fire with a loss of $30,000.

Inquiries Lighter in Chicago District

MANUFACTURERS of foundry equipment in the Chicago district, in addition to finding it difficult to close deals, now find inquiries scarce. Foundries engaged in automobile work have received some cancellations of contracts. However, operations are fair and the let down in demand for new equipment is the offspring of sentiment that is more bearish than actual basic conditions warrant. The P. H. and F. M. Roots Co., Connersville, Ind., has placed one cupola blower each in the foundries of H. Humphrey & Sons, Joliet, Ill., and the Lindgren Foundry Co., Batavia, Ill. The Beardsley & Piper Co., Chicago, has received orders from the Kohler Co., Kohler, Wis., and the Columbia Sanitary Mfg. Co., Louisville, Ky., each for two stationary type sand throwing machines; from the Excelsior Tool & Machine Co., East St. Louis, Ill., the Dodge Mfg., Co., Mishawaka, Ind., and Ohio Steel Castings Co., Cleveland, each for one of the portable type; from the Central Foundry Co., Holt, Ala., for two of tractor type, and from the Eastern Foundry Co., Boyertown, Pa., for one tractor unit.

The Whiting Corp., Harvey, Ill., recently has received orders for one cupola each from the Buckeye Foundry Co., Cincinnati; the Hardwick Stove Co., Cleveland, Tenn., and the school commissioners of Indianapolis. The Studebaker Corp., South Bend, Ind., has ordered 35 tumbling barrels from the Whiting Corp. This maker of foundry equipment also has placed two cupolas and a 2-ton elevator for the new plant of the Warren Foundry Co., Warren, O. This company also has sold ladles to the Lakely Foundry & Machine Co., Muskegon, Mich, and the Chandler Taylor Co., Indianapolis. The National Engineering Co., Chicago, has placed its sand mixers in the plants of the Brown Car Wheel Works, Buffalo; the William Cramp & Sons Ship & Engine Building Co., Philadelphia, and the Cadillac Motor Car Co., Detroit. The W. W. Sly Mfg. Co., Cleveland, has sold a sand blast mill with bucket elevator and pressure tank to the Belle City Malleable Iron Co., Racine, Wis., and the Western Malleable Co., Beaver Dam, Wis. This manufacturer also sold sand blast equipment to the Rich Steel Products Co., Battle Creek, Mich. Tumbling barrel equipment has been purchased by the General Electric Co., Ft. Wayne, Ind.; the United States Radiator Corp., Detroit; Dodge Bros., Detroit; the Albion Malleable Iron Co., Albion, Mich.; the H. Wetter Mfg. Co.; South Pittsburgh, Tenn., and the Pullman Co., Michigan City, Ind. The Quincy Stove Mfg. Co., Quincy, Ill., has purchased dust arrester equipment. The Pangborn Corp., Hagerstown, Md., has sold sand blast and dust arrester equipment to the Bettendorf Co., Bettendorf, Ia., and dust arrester equipment to the Packard Motor Car Co., Detroit, and the Locomotive Finished Material Co., Atchinson, Kans.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

The Pacific Malleable Castings Co., Oakland, Cal., is constructing a foundry at the foot of Eighty-fifth avenue, that city.

Simms Foundry Corp., 930 Tenth avenue, Racine, Wis., operator of two foundries contemplates plant additions this spring.

The Western Iron & Foundry Co., Wichita, Kans., expects to have plans ready for expansion within several months.

The Western Foundry & Machine Works, 261 Jefferson street, Topeka, Kans., has plans for a plant addition.

The Detroit Stoker Co., Detroit, is moving its foundry in Toledo, O., to Bowling Green, O., and has started operations in the latter place.

Boston navy yard will have its foundry improved and enlarged if $45,000 addition to the naval appropriation bill for that purpose is passed by Congress.

The American Hardware Corp., New Britain, Conn., will erect 6-story addition to the Russel & Erwin division in that city. The company operates gray iron and brass foundries.

Marchant's Foundry, Oakland, Cal., is constructing a foundry at East Tenth street near High street. The company operates a gray iron foundry at Emeryville, Cal.

Watson Frye Co., Bath, Me., has been incorporated for $200,000 to conduct a general foundry and machine shop business, to mine and transport coal, iron, etc.

Otis Elevator Co., New York, has purchased property adjoining its plant at Yonkers, N. Y., where it contemplates expansion. Company operates gray iron, brass and aluminum foundries.

James Bros. Foundry Co., Perth, Ont., it is reported is asking prices on molding machinery, ladles, lathes and other equipment for foundry addition. The company operates gray iron, brass and aluminum foundries.

M. Hertenstein Co., 1409 South High street, Columbus, O., was damaged by fire recently. Reconstruction will begin at once. Company manufactures stoves and operates gray iron foundry.

Walworth Run Foundry Co., 2488 West Twenty-seventh street, Cleveland, has purchased a 2-acre site adjoining its present plant which will be used for expansion. The company operates gray iron foundry.

Waterhouse Brass Foundry, Wheeling, W. Va., has taken an option on a site at Wood and Twenty-fifth street, where it proposes to make extensive improvements. Plant will be operated as a modern brass foundry.

The Florida Co-Operative Machinery Co., Birmingham, Ala., has removed from that city to Tampa, Fla. Company operates machine shop and does general foundry work. J. Heinze is president.

Cohoes Iron Foundry & Machine Co., Albany, N. Y., was incorporated recently for $50,000. The company had been operating a foundry and machine shop for about 25 years according to A. P. McKean, Troy, N. Y., attorney and one of the new incorporators.

Arrangements have been completed whereby the Burr Foundry & Machine Co., Boston, will acquire and operate the Humpreys Machine Co., Keene, N. H. The Burr company is incorporated for $65,000 and is headed by David E. Burr, president and treasurer. The foundry,

machine shops and pattern shops of the Humphreys plant will be operated in Keene, N. H.

Ness Electric Welding Machine Co., New York, has been incorporated for $100,000 to build welding machinery and other equipment, by H. J. and M. A. Ness and D. T. Pape, with D. A. Wilson, 15 Park Row, New York, as attorney.

The Nagel-Wallace Brass Works, 3529 Michigan avenue, Detroit, plans enlargements to its manufacturing plant, according to William Nagel, president. The company fabricates copper and brass hardware and operates brass and aluminum foundries.

Plans have been prepared by Walker & Carswell, 1015 Chestnut street, Philadelphia, for a foundry and machine shop to be erected for H. S. Getty & Co., Inc., 1539 Cabot street, that city. The Getty company manufactures hardware.

The Central Foundry Corp., Milwaukee, has been incorporated for $75,000 by William E. Krause, Herman Deln and Leo J. Landry, attorney, 425 West Water street. The company will open a gray iron foundry in West Allis, Wis.

Hirst Mfg. Co., Ltd., Toronto, Ont., has been incorporated for $40,000 to manufacture iron, steel and metal products, to carry on business of casting, forging, and rolling, etc., by William B. McHenry, Henry E. C. Cornell and John F. Boland.

Fairfax Iron & Steel Co., Kansas City, Kans., soon will start construction of plant 100 x 600 or 700 feet, for which it has retained Horner & Wyatt, engineer. The company was to be incorporated with a capital of $1,000,000. It will operate steel, gray iron and malleable foundries.

American Bell & Foundry Co., has sold its plant at Northville, Mich., to Parker & Genkins, Howell, Mich., who are organizing a company to operate the company under the name of American Bell & Furnace Co. Frank Harmon was president of the old company.

Carthage Machine Co. of Canada, Ltd., Belleville, Ont., has been incorporated for $120,000 to acquire and take over and operate the plant and business of the J. C. Wilson Mfg. Co., Ltd., 11 Water street, operator of gray iron and brass foundries. The new company, incorporated by Addison F. Wardwell, Watertown, N. Y.; Arthur K. Hinds, Carthage, N. Y. and Fred S. Wilson and Francis E. O'Flynn, Belleville, will manufacture and assemble machinery, do metal casting and carry on a general foundry business.

Plans are ready as prepared by Paul Gerhardt, 64 West Randolph street, Chicago, for 6-story reinforced concrete plant at Chicago for A. J. Lindemann & Hoverson Co., First to Fourth and Cleveland avenues, Milwaukee, operator of gray iron, malleable, brass and aluminum foundries and manufacturer of stoves.

The branch plant at Holt, Ala., of the Central Iron & Coal Co. and the Cenrtal Foundry Co. will be enlarged with a 140 x 420-foot addition to No. 3 pipe foundry. Another cupola house will be built, 40 x 60 feet. Ingalls Iron Works Co., Birmingham Ala., has been awarded the contract for constructing additions.

The foundry of the Hynes-Langenberg Mfg. Co., St. Louis, now nearing completion is expected to be in operation late in April or early in May. The company, which manufactures steel furnaces, will make all its own castings with the new equipment which is being installed.

The Hercules Steel Casting Co., Milwaukee, has been taken over by the Pawling & Harnischfeger Co., manufacturer of cranes, machine tools, hoists, etc. The steel castings foundry which the Pawling company acquired in the purchase has a capacity of 1200 to 1500 tons a month with one 10-ton electric furnace.

Clancy Malleable Corp., Janesville, Wis., headed by A. R. Clancy, formerly of the General Motors Co., will construct and operate malleable iron foundries. The plant formerly used by the Sampson Tractor Co. on South River street, is being converted into a foundry also. The company will make castings for the automotive industry.

The H. & R. Foundry Co., Cincinnati, recently incorporated as noted in the April 1 issue of THE FOUNDRY, has taken over the plant of the Phoenix Foundry Co., Wade street, that city. The new company will manufacture bronze, brass and aluminum castings. Arthur Remers is president and Harry Hinken secretary and treasurer. The officers formerly were connected with the Ohio Pattern Works, Cincinnati.

New Trade Publications

WELDING TORCHES—Gooseneck welding torches made by the Bastian-Blessing Co., Chicago, are described and illustrated in a bulletin recently published. A new series of torches for the entire range of welding work is being offered in various sizes.

MICROMETERS—In a 24-page booklet the Reed Small Tool Works, Worcester, Mass., describes recent additions to its line of micrometers, with special attention paid to improved designs. Tables of English and metric measurements are given, with instructions for use.

REFRACTORY LININGS—The Quigley Furnace Specialties Co., New York, in 16 pages of pocket size booklet describes its refractory ganister lining for furnaces. Halftones of actual methods are included and varied uses are presented to indicate the versatility of the material.

MINE-CAR AIR COMPRESSOR—The Sullivan Machinery Co., Chicago, has issued a 16-page booklet uniform with its series describing portable mine-car air compressor. While designed especially for mine work and used most largely in coal mines, they also serve to supply air drills in remote workings, pneumatic tools in steel construction and in various locations where small volumes of air are required for short periods at remote points. Illustrations are presented of the machine and its parts showing operation under various conditions.

AIR COMPRESSORS—Equipment for compressing air in various industries is described in a 32-page catalogue by the Champion Pneumatic Machinery Co., Chicago. Single and two-stage compressors are featured in various sizes, with halftone illustrations and full specifications of each.

HELICAL TUBE RECORDER—Recording, controlling and indicating instruments employing a helical tube to actuate the pen arm are described in a bulletin by the Foxboro Co., Inc., Foxboro, Mass. This is claimed by the makers to be a new principle that eliminates some defects in continued operation.

LOCOMOTIVE CRANES—In a recent bulletin the McMyler-Interstate Co., Cleveland, refers to its 40 years of building cranes, and describes and illustrates its convertible type of crane which may be operated by steam, electricity or gasoline. The crane may be mounted on crawlers, tractor wheels, or railroad rails and used with dragline, bucket, shovel or magnet. Construction and parts are illustrated, as also is actual operation.

TANKS—Presenting a dictionary of "Tankology" to indicate its understanding of what a tank should consist, S. F. Bowser & Co., Fort Wayne, Ind., is sending the trade an 8-page leaflet. The leaflet sets forth these ideals and the long experience of the organization in building containers.

POWER PLANT LUBRICATION—Extensive consideration of the proper lubrication of power plant machinery is presented in a 60-page book just issued by the Tide Water Oil Sales Corp., New York. Beginning with definitions of friction and lubrication the book discusses various types of bearings and lubricants and the several methods of applying the latter.

SAND BLAST EQUIPMENT — Various types of devices for applying a current of air loaded with abrasive material to castings to clean them are presented in a 4-page leaflet by the Pangborn Corp., Hagerstown, Md. Barrels, rotary tables, rooms and cabinets, each suited to a particular use, are suggested.

AUTOMATIC TEMPERATURE CONTROL—F. J. Ryan & Co., Wesley building, Philadelphia, present an 8-page booklet describing control of temperature in gas and oil-fired furnaces and the necessity of such control in industry. In this small compass full discussion is not attempted but the subject is covered sufficiently to indicate its value and the efficiency of the methods employed.

HEAT ENDURING CASTINGS—The Calorizing Co., Pittsburgh, in a catalog of 20 pages describes castings produced by its process for use in high temperatures for retorts, annealing boxes, heat treating boxes, furnace parts and similar uses. Illustrations of various installations, a heat-color chart and conversion table of Fahrenheit and Centigrade scales completes the book.

WATER SOFTENERS—A pamphlet by David Henderson of the Dravo-Doyle Co., Pittsburgh, on treatment of boiler feed water for overloaded boilers, is being issued by the H. S. B. W. Cochrane Corp., Philadelphia. It discusses various softening processes and softeners and approves the lime soda process and preliminary heating of feed water, followed by filtration through a nonsiliceous material.

COBALT—A booklet on cobalt has been received by deCourcy Browne, Inc., 120 Broadway, from Henry Wiggin & Co., Ltd., Birmingham, Eng. It tells the sources, refining methods, commercial products and the uses of its compounds in ceramics, paints, driers and enamels, physical properties and use in ferrous and nonferrous alloys. It is sent on request to deCourcy Browne, Inc.

STEEL BELT CONVEYORS—Automatic transportation of materials by a rolling or sliding endless steel belt is described in a 24-page catalog of Steel Belt Conveyors, Ltd., Congreve street, Birmingham, Eng. Application of the conveyor principle is outlined and details of installations are shown with illustrations from photographs of actual conveyors at work. Doing away with labor to load and unload and continuous delivery of product are claimed as advantages.

UNDERFEED STOKERS—An attractive book of 64 pages has been issued by the Sanford Riley Stoker Co., Neponset, Mass., and sets forth completely the construction, theory and operation of the underfeed stoker. Considerable engineering data are presented, with drawings of typical settings, evaporation curves and other information included. The book is well illustrated with views showing stokers in actual service.